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ABSTRACT

This document provides guidance on accommodations in secondary schools, concentrating on the needs of 11- to 16-year-old pupils. The guidance is intended to assist all those who may be involved in the briefing and design process. It discusses the issues that arise when considering both new and existing accommodations. The document covers the range of teaching and non-teaching spaces likely to be required, and gives guidance on planning a suite of spaces with reference to the acoustic environment. It also describes the size, shape, and planning of teaching and non-teaching spaces; gives advice on furniture used in each type of space; provides a brief guide to the mechanical and electrical servicing requirements for music spaces; and outlines some of the key points of environment design. Concluding sections provide case studies showing the application of this guidance to existing schools and general cost information and analysis using one of the case studies. Appendices include a checklist of design considerations and two glossaries. (Contains 24 references.) (GR)

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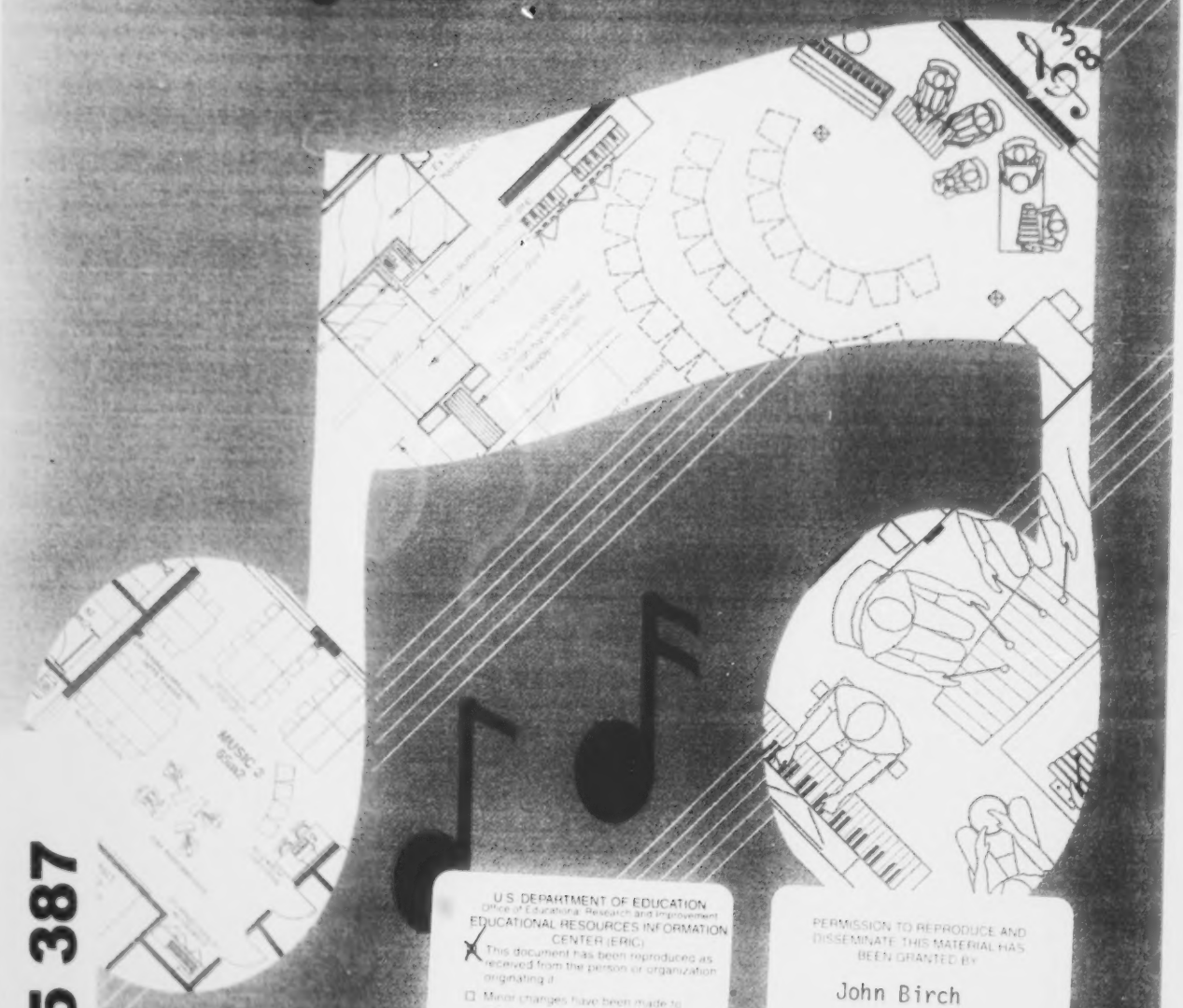
MUSIC ACCOMMODATION IN SECONDARY SCHOOLS

A Design Guide



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Music Accommodation in Secondary Schools

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Introduction

This publication provides guidance on accommodation for music in secondary schools. The guidance is intended to assist all those who may be involved in the briefing and design process including teachers, governors, LEA advisers and building professionals. It discusses the issues that arise when considering both new and existing accommodation.

Within the National Curriculum, music is compulsory in Key Stage 3 (KS3) and optional in KS4. The vast majority of secondary schools offer music in KS4 and those with sixth forms frequently provide courses at A and AS level. A GNVQ course, which includes considerable use of music technology, may also be offered. Teaching methods have changed significantly in the last two decades with the emphasis moving from whole class teaching to a mixture of whole class and small group practical work and a high level of individual involvement in performing and composing. Technological advances offer greater access to electronic instruments and more sophisticated recording methods.

Schools vary in the way in which they choose to deliver their curriculum within the requirements of the National Curriculum and this affects their accommodation needs. Local authorities and schools will establish their own building priorities in the light of the funds they have available for capital work and any conditions which may attach to these funds. They will also wish to consider any additional recurrent costs that may result from building work. The guidance given is not, therefore, prescriptive; the information is flexible enough to be applied to a range of different situations. The publication concentrates on the needs of 11 to 16 year old pupils and there is no specific advice about pupils with special educational needs. However, the general guidance will be applicable to all secondary schools and the case studies illustrate a range of school types including those with sixth forms.

It is recommended that the accommodation requirements of music are considered in the context of the whole curriculum and that both specialist advisers and building professionals, as well as teachers, are involved with the analysis and planning.

The publication begins with a broad outline of accommodation needs with each aspect then covered in greater detail; a summary of the content is given here.

Section 1: The Music Suite provides a guide to the range of teaching and non-teaching spaces that are likely to be required. It also gives some guidance on planning a suite of spaces including reference to the acoustic environment.

Section 2: Individual Spaces describes the size, shape and planning of teaching and non-teaching spaces. It is illustrated by furnished layouts of typical spaces.

Section 3: Furniture gives detailed advice on furniture used in teaching and non-teaching spaces.

Section 4: Services and Environmental Design provides a brief guide to the mechanical and electrical servicing requirements for music spaces and outlines some of the key points of environmental design. Acoustic design is covered in particular detail.

Section 5: Case Studies shows the application of the guidance to existing schools by illustrating schemes for new and adapted music departments.

Section 6: Cost Guidance provides general cost information and a cost analysis of one of the case studies.

Appendices include a Check List of Design Considerations and two Glossaries.

Section 1: The Music Suite

This section provides an introduction to the nature of secondary school music and outlines the range of spaces that may be found in a music suite. The guidance on planning includes issues associated with the acoustic environment.

The Music Curriculum

1.1 The National Curriculum Programmes of Study in music have a strongly practical emphasis and involve pupils in composing, performing, listening and appraising. Pupils have opportunities to sing and to play a range of acoustic and electronic instruments, working individually, in small groups, or as a whole class. Performances take place informally within the class or formally to audiences of varying size. The recording of pupils' work is an essential element which develops their understanding and facilitates evaluation (see Glossary I). Related activities may include listening to live or recorded music, or group discussion.

1.2 In addition to the timetabled classes for music, many pupils have instrumental or vocal lessons in school, usually taught individually or in small groups by peripatetic teachers. These lessons last for 15 to 30 minutes and can take place throughout the school day during lesson time and break periods as well as before and after school. Pupils may also practise their instruments in school in their own time. The number of pupils learning an instrument will vary widely between schools. A typical figure may be 10% of the numbers on roll but in some cases this may increase to 20% or even 40% in a school with a particular music focus. There are also extended curricular activities where pupils take part in and perform with a variety of musical groups including brass bands, string ensembles, rock bands, steel pans, choirs or a whole school orchestra. These will vary in size but the largest are likely to be the choir, orchestra or big band which can exceed 100 pupils. There may also be after-school use of the music department by the community.

Teaching Spaces

The Range of Spaces

1.3 A music suite may be expected to have one or more whole-class teaching spaces supported by a series of smaller rooms. The occasional use of a space that can be used for formal performances or for rehearsals by larger groups such as the school orchestra is also desirable. Depending on the nature of the activity, this may be an assembly hall or a studio space that is shared with drama or dance. The range of teaching spaces can be summarised as follows.

- **A music classroom** used for whole class composing, listening, appraising and performing. It can also be used for non-practical work such as research and will serve as a rehearsal and performance space for some extended curricular activities. However, when a class is divided into a number of small groups for music-making activities such as composing, the variety and level of sound can become uncomfortable in one space and pupils may have difficulty hearing their work. It is therefore desirable to have access to other spaces nearby.
- **Group rooms** (or larger ensemble rooms) where small groups of pupils can work on a composition for a part of the lesson. These spaces can also be used for instrumental lessons and practice.
- **A recording/control room** for producing good quality recordings of pupils' performances, particularly in KS4 and post-16.

Calculating the Number of Timetabled Teaching Spaces (Music Classrooms)

1.4 The total number of timetabled spaces needed is generated by the total number of teaching periods. The number of teaching periods will depend on a school's curriculum and timetabling organisation including group sizes, the number of pupils

Model A

School Size	KS	TP	Total TP	No. Spaces Calculated	No. Spaces Rounded	f/use %	Notes
	10% take-up at GCSE						
Total PPW: 40 Music PPW KS3: 2(5%) KS4: 4(10%)	**600**	**KS3**	24				
		KS4	8	32	0.80	1	80%	
	750	**KS3**	30				
		KS4	8	38	0.95	2	48%	low f/use
	900	**KS3**	36				
		KS4	8	44	1.10	2	55%	low f/use
	1050	**KS3**	42				
		KS4	8	50	1.25	2	63%	
	1200	**KS3**	48				
		KS4	8	56	1.40	2	70%	
	1350	**KS3**	54				
		KS4	16	70	1.75	3	58%	2@88%
	1500	**KS3**	60				
		KS4	16	76	1.90	3	63%	
	20% take-up at GCSE						
	600	**KS3**	24				
		KS4	8	32	0.80	1	80%	
	750	**KS3**	30				
		KS4	16	46	1.15	2	58%	low f/use
	900	**KS3**	36				
		KS4	16	52	1.30	2	65%	
	1050	**KS3**	42				
		KS4	16	58	1.45	2	73%	
	1200	**KS3**	48				
		KS4	16	64	1.60	2	80%	
	1350	**KS3**	54				
		KS4	24	78	1.95	3	65%	
	1500	**KS3**	60				
		KS4	24	84	2.10	3	70%	

Model B

School Size	KS	TP	Total TP	No. Spaces Calculated	No. Spaces Rounded	f/use %	Notes
	10% take-up at GCSE						
Total PPF: 50 Music PPF KS3: 3(6%) KS4: 5(10%)	**600**	**KS3**	36				
		KS4	10	46	0.92	2	46%	low f/use
	750	**KS3**	45				
		KS4	10	55	1.10	2	55%	low f/use
	900	**KS3**	54				
		KS4	10	64	1.28	2	64%	
	1050	**KS3**	63				
		KS4	10	73	1.46	2	73%	
	1200	**KS3**	72				
		KS4	10	82	1.64	2	82%	
	1350	**KS3**	81				
		KS4	20	101	2.02	3	67%	
	1500	**KS3**	90				
		KS4	20	110	2.20	3	73%	
	20% take-up at GCSE						
	600	**KS3**	36				
		KS4	10	46	0.96	2	46%	low f/use
	750	**KS3**	45				
		KS4	20	65	1.30	2	65%	
	900	**KS3**	54				
		KS4	20	74	1.48	2	74%	
	1050	**KS3**	63				
		KS4	20	83	1.66	2	83%	
	1200	**KS3**	72				
		KS4	20	92	1.84	3	61%	
	1350	**KS3**	81				
		KS4	30	111	2.22	3	74%	
	1500	**KS3**	90				
		KS4	30	120	2.40	3	80%	

Figure 1/1
Number of spaces for 2 models

Key
PPW = periods per week
PPF = periods per fortnight
TP = teaching periods
f/use = frequency of use
KS = key stage

Notes
[1] The Dearing revision of the National Curriculum is based on a recommended minimum of 45 hours of music per year in KS3. In most schools this is equivalent to about 5% of curriculum time.

choosing music as an option in KS4 and, in an 11-18 school, the number of pupils taking music in the sixth form.

1.5 Figure 1/1 shows the number of music classrooms that are generated by two curriculum models, reflecting typical situations in schools. For each model, the curricular percentage is constant in KS4 (10%) and in KS3 ranges from 5% (model A) to 6% (model B).[1] The 'take-up' in KS4 varies from school to school and from year to year. These models show two options for the GCSE 'take-up': 10% and 20% of the year group. The higher figure is not often exceeded at present, the current national average is around 10%. For the purposes of this publication, maximum group sizes are taken as 30 in KS3 and 24 in KS4. The increase in GCSE 'take-up', from 10% to 20%, only affects the total number of spaces in one case (model B, 1200 school). There are two reasons for this: either extra pupils can be accommodated without generating another group or the frequency of use of the space(s) is sufficiently low to allow for increased timetabling.

1.6 The average frequency of use of the spaces is shown in the table – this is the number of periods a space is used as a

percentage of the total number of periods available. Where rounding up to the nearest whole number of spaces results in a frequency of use over 90%, the next highest number of rooms is given. Where the frequency of use lies between 85% and 90% (as in Model A, 1350 pupils) two figures are given.[2] The use of music spaces will be considered in the context of the accommodation and the number of teachers in the school as a whole and where the average frequency of use of a space falls below about 60%, one of the spaces may occasionally be used by other departments. This could occur, for example, in the 750 place school teaching curriculum model A.

1.7 Figure 1/1 reflects the needs of an 11 to 16 school. A GCE A-level group in an 11 to 18 school can usually be timetabled into one of the music classrooms or an ensemble room. Pupils will also use the group rooms and recording/control room (the latter in particular for music technology courses). In cases where the average frequency of use of the spaces is very high and the A-level group is large, an additional ensemble room may be justified.

The Size of Timetabled Teaching Spaces

1.8 Figure 1/2 shows suggested area ranges for a music space according to group size.[3] **A music classroom of 60-70m²** (from the upper part of zone B) will accommodate up to 30 pupils involved in a range of practical and non-practical activities. A larger space from zone D (79-91m²) will serve as a base for a range of extended curricular activities such as choir practice or recitals, in addition to normal classroom activities. Such a space (sometimes called a recital room) can also be used by the community as a recital/rehearsal space after school hours. It is desirable to have one space of this size in every music department, particularly where there is a strong extended curricular/community element or where access to other large spaces is limited.

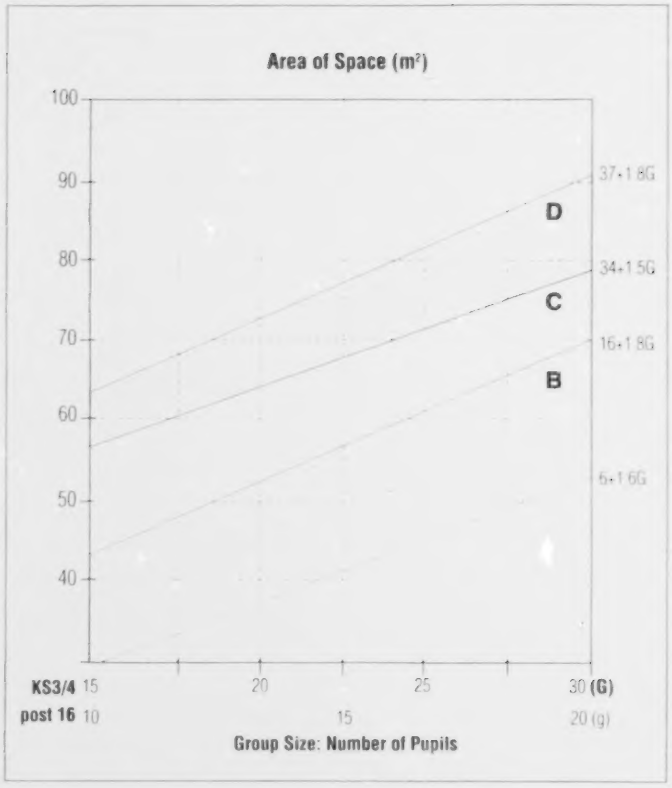

Figure 1/2
Area range for music according to group size

Group Rooms and Ensemble Rooms

1.9 These rooms are used as support to classwork and for instrumental lessons. If a music room has access to four **group rooms** a class of 30 pupils can be divided into five small groups for practical activities such as composing. Where there are two or more main teaching spaces, the ratio may be reduced depending on the need for each music classroom to have simultaneous access to group rooms. These rooms can also be used for instrumental teaching and practice. The size of such a space will range from **6-8m²**, depending on the type and number of instruments involved. Rooms of varying size will offer the most flexibility. Further detail on the size, shape and furniture layout of timetabled and supplementary teaching spaces is given in Section 2.

Notes

[2] Although a high frequency of use of all spaces is desirable, it may be difficult in specialist rooms to organise the timetable to achieve a frequency of use over 85%.

[3] The graph is based on the formulae shown alongside, where G (or g) = group size. It is extracted from Area Guidelines for Schools (BB82), DfEE 1996.

1.10 There will be an occasional need for a bigger group room where 8-12 pupils can work together or where larger instruments can be played; this space is usually referred to as an **ensemble room**. It is common to designate one of the group rooms as the main instrumental base that can be available for part, if not all, of the school day for peripatetic teaching. This is often the ensemble room which as a larger space provides a more comfortable and versatile environment. However, the use of these spaces will have to be fairly flexible to accommodate the irregularities of the peripatetic timetable and allow for varying group sizes in both composition and instrumental work. A space of **20-25m²** allows groups of up to 12 pupils to work. The use of very large instruments or groups of instruments may need to be considered (see paragraph 2.21, Section 2).

Recording/Control Room

1.11 A **recording/control room** is a space containing equipment which controls the recording of a performance in this or other spaces.[4] A room of about **10-15m²** will accommodate appropriate recording equipment and 2 or 3 people. In class music sessions, this space often doubles as a group room for composition work. It may also be timetabled for A-level music technology. A **recording studio**, as a performance space to be used in conjunction with a control room, is sometimes provided in more specialised accommodation.

Schedules of Teaching Spaces

1.12 Figure 1/3 shows the range of spaces that may be provided for music in 11-16 schools. These models apply mainly to new music suites but they can also be used as a guide in adaptation projects. The number of timetabled spaces is derived from the curricular models described in Figure 1/1. A take-up of 10% in KS4 has been shown. It is assumed that 10% of pupils have instrumental lessons, half taught individually and half in groups of three or four. The overall teaching area in these models is 3.7-4.8m² per work place. It is higher where the smaller spaces are less effectively used. The following criteria have been applied.

- Each school has one music room which is large enough to accommodate extended curricular activities such as recitals or medium sized rehearsals (85m²). All other classrooms are large enough for a range of practical and non-practical activities (65m²). These spaces may be shared with other departments where the frequency of use is low (see paragraph 1.6).
- Each school has an ensemble room (20m²), primarily for instrumental lessons. Larger schools have two such spaces to allow for the greater number of pupils likely to be taking instrumental classes (unless there is adequate 'spare' capacity in group rooms).
- Generally, there are four supporting group rooms for each timetabled classroom, ensuring that rooms for composing will be available for every timetabled lesson. In some cases the ensemble room is counted as one of the four. However, where the average frequency of use of timetabled rooms falls below 60% and group rooms are not required for instrumental lessons, a full complement of group rooms may not be justified and schools may choose to organise their activities to suit fewer rooms. The cases where the number of group rooms may be reduced are highlighted on the table.
- For the purposes of calculation, it is assumed that almost all instrumental lessons take place in the ensemble room with a few in the smaller group rooms as timetabling allows. In practice there is unlikely to be a rigid dividing line between the use of the ensemble room and other group rooms.

Notes

[4] The room associated with a drama space which controls stage lighting is often referred to as the Control Room. The two control room functions may be combined in a single room when attached to a multi-purpose performance space.

Model A	School Size	Class/ Recital (85m²)		Class (65m²)		Ensemble (20m²)		Group (ave. 7m²)[5]		Recording/ Control (10m²)		Total Area	Total Area per WP	Ave t/use Main Space
		no.	area	no.	area	no.	area	no.	area	no.	area	m²	m²	
40 PPW KS3 5% KS4 10% 10% take-up at KS4 10% pupils take instrumental lessons	600	1	85			1	20	4	28	1	10	143	4.8	80%
	750	1	85	1	65	1	20	7	49	1	10	229	3.8	48%
	900	1	85	1	65	1	20	7	49	1	10	229	3.8	55%
	1050	1	85	1	65	1	20	7	49	1	10	229	3.8	63%
	1200	1	85	1	65	2	40	8	56	1	10	256	4.3	70%
	1350	1	85	2	130	2	40	10	70	1	10	335	3.7	58%
	1500	1	85	2	130	2	40	10	70	1	10	335	3.7	63%

Model B	School Size	Class/ Recital (85m²)		Class (65m²)		Ensemble (20m²)		Group (ave. 7m²)[5]		Recording/ Control (10m²)		Total Area	Total Area per WP	Ave t/use Main Space
		no.	area	no.	area	no.	area	no.	area	no.	area	m²	m²	
50 PPF KS3 6% KS4 10% 10% take-up at KS4 10% pupils take instrumental lessons	600	1	85	1	65	1	20	7	49	1	10	229	3.8	46%
	750	1	85	1	65	1	20	8	56	1	10	236	3.9	55%
	900	1	85	1	65	1	20	8	56	1	10	236	3.9	64%
	1050	1	85	1	65	2	40	7	49	1	10	249	4.2	73%
	1200	1	85	1	65	2	40	8	56	1	10	256	4.3	82%
	1350	1	85	2	130	2	40	12	84	1	10	349	3.9	67%
	1500	1	85	2	130	2	40	12	84	1	10	349	4.0	73%

Figure 1/3
Range of music spaces for 2 models

Key

PPW = periods per week
PPF = periods per fortnight
KS = key stage
WP = workplace
t/use = frequency of use
= possible reduction in group rooms

Notes

[5] The size of group rooms will vary. An average of 7m² is assumed for these models. See Section 2 for further discussion on group room sizes.

Non-Teaching Spaces

Store Rooms

1.13 Some items, such as percussion instruments and reference material, will be kept in the classroom where they are visible and easily accessible. Other class resources will be kept in a **classroom store**. School instruments that are used for extended curricular activities or occasional classwork are usually kept in a separate and secure **instrument store**. This is also where pupils can leave their own instruments, brought in for instrumental lessons or classwork. Some schools also use the group rooms for storage. This can make the best use of available space but needs careful management to ensure the room remains usable as a group room and to avoid problems of accessibility or damage to delicate items. A staff base may be used for secure storage.

1.14 An overall area of **0.3-0.4m² per workplace** can be used as a rough guide when calculating storage area but requirements will have to be individually determined because school instrument stocks vary so widely. Sections 2 and 3 provide detailed guidance on the size and shape of store rooms and on specialist storage systems.

Staff Bases

1.15 It is desirable to have a teachers' base for meetings, preparation and storage. This room usually doubles as an office for peripatetic staff and in some instances may also be used as a group room. In some schools there are a number of peripatetic and part-time teachers as well as some part-time administrative support staff. A secure store attached to the staff base is an advantage for pupils' records and certain pieces of equipment.

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Planning Principles

1.16 An appropriate acoustic environment is more important in music accommodation than in most other areas of the school. In general the aim is to enable people to hear music clearly without distraction and with suitable enhancement by the room acoustic. The two main issues are sound quality and acoustic insulation. The quality of musical sounds is affected principally by room proportion and surface finishes although other factors are also important. Sound insulation, to avoid disturbance from unwanted sounds, is affected by planning, structure and constructional detail. The principles of acoustic design are summarised in Section 4 and covered in more detail in other publications, listed in the Bibliography. The ways in which planning can affect acoustic insulation are discussed here.

1.17 When a music department is being planned, the first decision may be its location on the school site. Two of the factors that may affect this decision are:

- security: there are many valuable instruments in a music department, including electronic keyboards and computers;
- acoustics: the music department should not be disturbed by external noise such as a busy road or the playground. Conversely, noise generated from within the music department should not disturb neighbouring activities.

1.18 If a new building is planned, the music department may be designed either as a separate 'block' or as an integral part of the main school. **An integral department** can have the following advantages:

- it is identifiable as at the heart of the school;
- the school hall (if nearby) can be easily accessed for performance and rehearsal activities;
- there are more possibilities for sharing spaces across departments, for example where the music curriculum only demands 50% use of a second space.

However:

- it may be more difficult to ensure adequate acoustic insulation between the music department and other spaces.

A separate building can have the following advantages:

- the separation will minimise acoustic disturbance to and from the music department;
- the building can be used independently of the main school buildings for community use.

However:

- it may be more difficult to create a sense of integration with the rest of the school;
- there will be external circulation between the music department and the rest of the school.

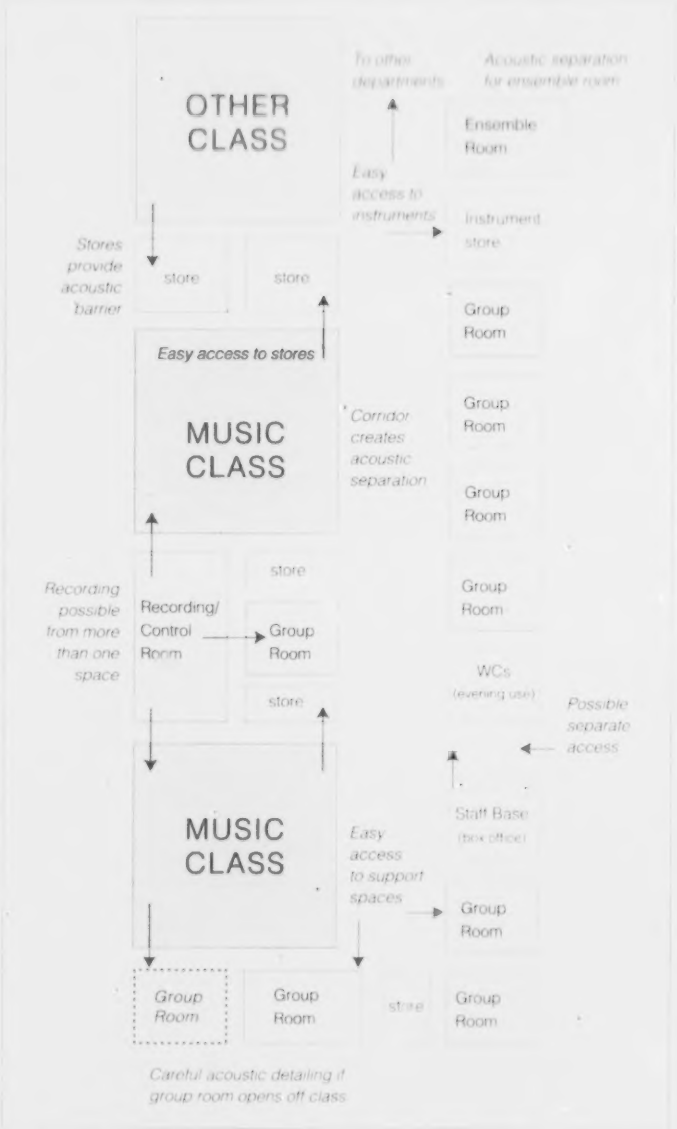
1.19 Separate music departments are sometimes designed as a 'pavilion' with a strong geometric form. This may be difficult to adapt to changing needs in the future.

1.20 Figure 1/4 illustrates planning principles to be considered whether building new or adapting existing accommodation for music. This example indicates a department that is attached to the main part of the school but most of the points apply equally to a separate block.

- If all music accommodation is located in the same area, equipment (such as that used for recording musical performances) and instruments can be shared more effectively. Supplementary teaching spaces such as an ensemble room or recording/control room can be accessed by more than one class and it is easier to co-ordinate the peripatetic activities with the rest of the music department.
- If music rooms are to be used extensively after school hours it may be useful to be able to isolate the suite, for

security reasons.[6] If there is a separate external access it will need to be controlled and local toilet facilities may be provided.

- A music suite on one floor is preferable as it facilitates staff and pupils' use of shared spaces and makes supervision easier.
- Pupils should be able to access the instrument store without disturbing classes. Security should be considered when deciding the location of this store. Classroom stores should be easily accessed from the teaching space.
- 'Dead' spaces such as store rooms can act as buffers, providing effective sound insulation between two music rooms. The instrument store can provide useful acoustic separation between the main instrumental teaching room and other group rooms. A corridor can be used in the same way between the music classroom and the group rooms.
- Group rooms should be easily accessed, either directly from the teaching space[7] or via an adjacent corridor. The former requires more careful detailing to ensure adequate acoustic separation between the two rooms. It can also reduce flexibility because it is difficult for pupils from other classes or those taking instrumental lessons to use the spaces without inconveniencing the class.
- If there is a recording/control room, it should be possible to have visual as well as audio contact between this room and at least one music classroom.
- It may be desirable to provide one group room or ensemble room with a higher value of acoustic separation for recordings made for examination purposes. If such a space is adjacent to the recording/control room, there can be visual as well as audio contact during recording. Such a space will be particularly relevant in the context of GCSE examinations work.



- Toilets should, if possible, be located remotely from music spaces. Where this is unavoidable, measures should be taken to prevent transmission of noise generated by water flow.[8] In Figure 1/4, the toilets are intended for evening use when the group rooms would not be in use.

Figure 1/4
Planning principles to be considered

Notes

[6] It may also be convenient to provide separate zoning of services – see Section 4, para 4.1.

[7] This arrangement may be favoured because it facilitates supervision.

[8] Measures include avoiding mounting pipework on the party wall, or if this is not feasible, the use of pipe clamps fitted with resilient collars.

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Section 2: Individual Spaces

This section looks at the design of timetabled and supplementary teaching spaces and store rooms. Reference is made to some of the acoustic requirements of music spaces but these are dealt with in greater detail in Section 4.

Timetabled Teaching Spaces

2.1 In the music classroom pupils will be involved in a range of practical and non-practical activities including:

- whole class composing and performing (including singing), Figure 2/1a;
- whole class discussion/seminar/listening/evaluation, Figure 2/1b;
- individual or small group performance to the rest of the class;
- small group composing (while some pupils use group rooms), Figure 2/1c;
- whole class keyboard skills work;
- individual/small group research.

2.2 A range of instruments will be used including: orchestral and band instruments, tuned and untuned percussion, ethnic instruments, electronic keyboards and the voice. Computers can be used to co-ordinate and sometimes notate elements of composition work. CD ROM may be used to support listening and appraising.

2.3 A music classroom should have an appropriate acoustic environment for listening, composing and performing. It will also need to be furnished and equipped to accommodate this range of activities without excessive re-arrangement.

Notes

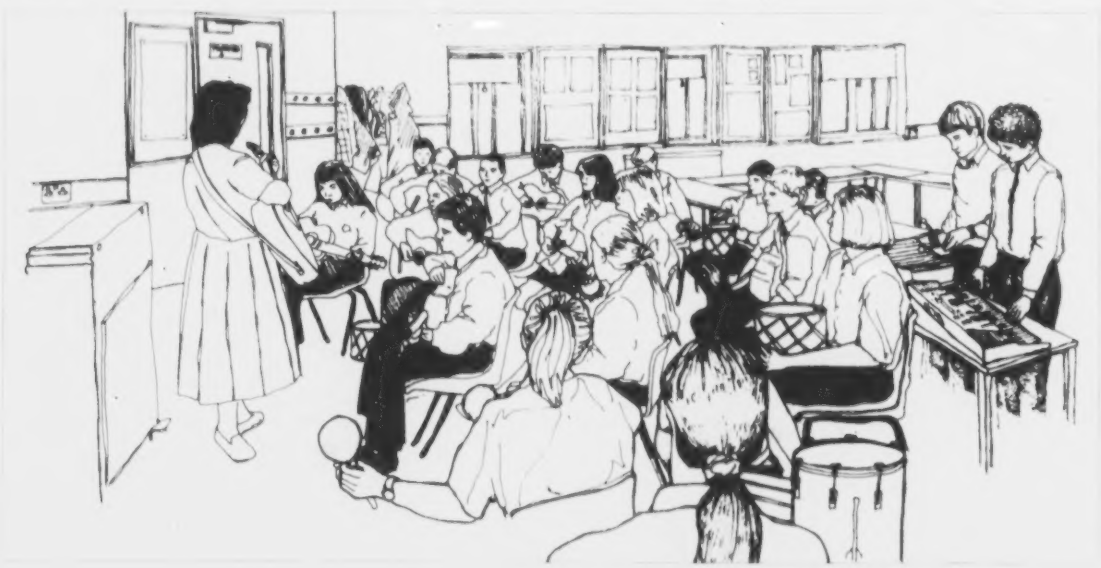
[1] For further explanation, see Section 4: Sound Quality.

The Size and Shape of a Music Classroom

2.4 Section 1 (paragraph 1.8) suggests that an area of **60-70m²** can accommodate up to 30 pupils engaged in a wide range of activities, some of which are listed in paragraph 2.1. A space of 54-60m² can also be suitable but some of the practical activities may be more difficult to manage and there may be some reduction in flexibility. Section 1 also refers to a larger space of **79-91m²** which can have additional use as a rehearsal and performance space. Spaces of 65m² and 85m² are illustrated in Figures 2/3 and 2/4.

2.5 The shape of a space can affect the way in which it can be used. A long narrow space may restrict whole class and performance activities and pupils at the back of a class may have difficulty hearing the teacher. Irregular plan shapes (eg. 'L' shaped) can reduce flexibility and make supervision difficult. For good acoustics, classrooms which are square (or based on a square) in plan and section should be avoided. Symmetrical geometric ceiling forms such as barrel vaults should also be avoided as they can cause undesirable focusing.[1]

Figure 2/1a
Whole class composing and performing



A Planning Strategy

2.6 Furniture and equipment (F&E) layouts are a valuable means of assessing the suitability of room size or shape at an early design stage and can be used to assess F&E needs and therefore budgets.

2.7 All the music classrooms shown in this document are intended to accommodate a wide range of activities with equal consideration to each part of the music curriculum. The F&E layouts follow a planning strategy which can be used as a guide to new or existing spaces. Each layout has the following characteristics:

- a notional zone is assumed (light pink in Figure 2/2), which forms about half the area and accommodates a series of temporary furniture layouts for varying activities including a performance to the class, whole class singing, or rehearsals;
- tables are generally positioned along two sides of the space (the dark pink zone in Figure 2/2) but they are loose and can be re-arranged to suit a range of activities;
- each layout provides a work surface for up to 30 pupils taking part in keyboard work[2], whole class composing with percussion or note taking;
- standing height fixed benching with storage and display above is concentrated on one wall; storage units (mobile or fixed) are assumed below;
- a teaching wall at 90° to the window wall includes positions for audio equipment, whiteboard(s) and a piano. From here there is a good view of the entrance and space as a whole;

Figure 2/1b
Evaluating a group performance

Figure 2/1c
Small group composing

- a recording/control room is assumed to be accessed from the teaching wall;
- coats and bags storage is provided by the room entrance;
- a free area (next to the entrance where possible) allows a computer trolley to be wheeled in when required.

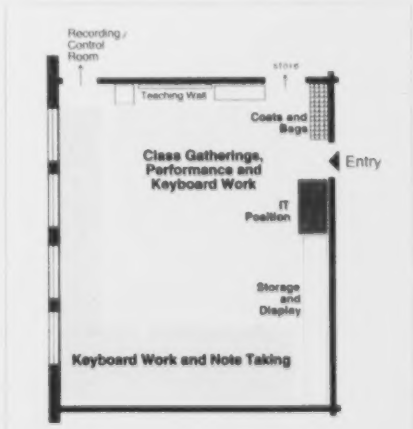


Figure 2/2
Zoning diagram layout for a music classroom

Notes
[2] Each layout allows for a provision of up to 15 keyboards.

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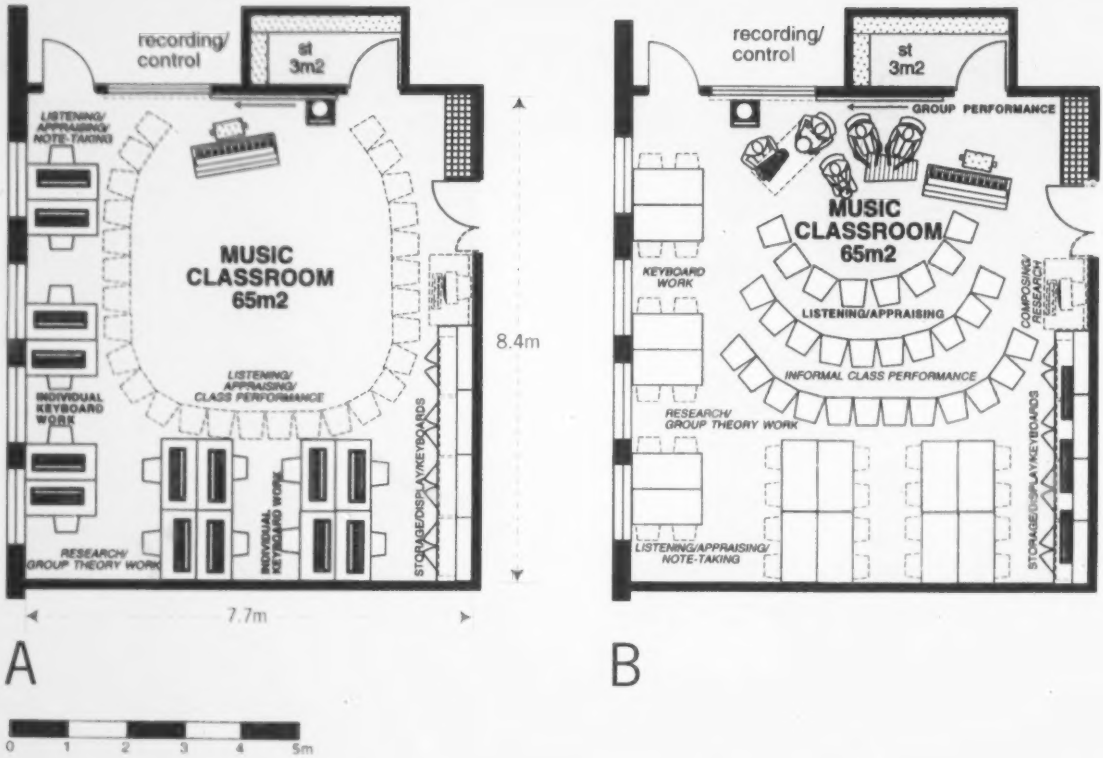

Figure 2/3 A & B
65m² music classroom planned for a range of activities

Key to Annotations

INDIVIDUAL KEYBOARD WORK = main activity shown

LISTENING/ APPRAISING = alternative activity

The Music Classroom Layouts

2.8 Figures 2/3 and 2/4 show how a music room planned according to the strategy outlined in paragraph 2.7 can accommodate a wide range of musical activities with a minimum of furniture re-arrangement. It is assumed that socket outlets are provided around the perimeter and in the floor. This gives flexibility by allowing keyboards to be used in any part of the room (see Section 4, 'Electricity'). More specialised equipment may be used for music technology, particularly at sixth form level, but this is not shown here.

2.9 Two sizes of space are shown, 65m² and 85m². All the layouts in the 65m² room show standard rectangular classroom tables (1200x600mm) but an alternative – a 15° trapezoidal table – is shown in the larger room. The shape of these tables makes a 'horseshoe' arrangement easy and allows good circulation space around the formation. The void which occurs when these tables are placed at 90° to a wall, allows a simple form of wire management or 'cable tidying' to be provided. Further information on tables and other items of furniture shown on these layouts can be found in Section 3.

2.10 One-and-a-half-leaf doors provide a wider opening which may be useful when moving bulky items such as a piano between rooms.

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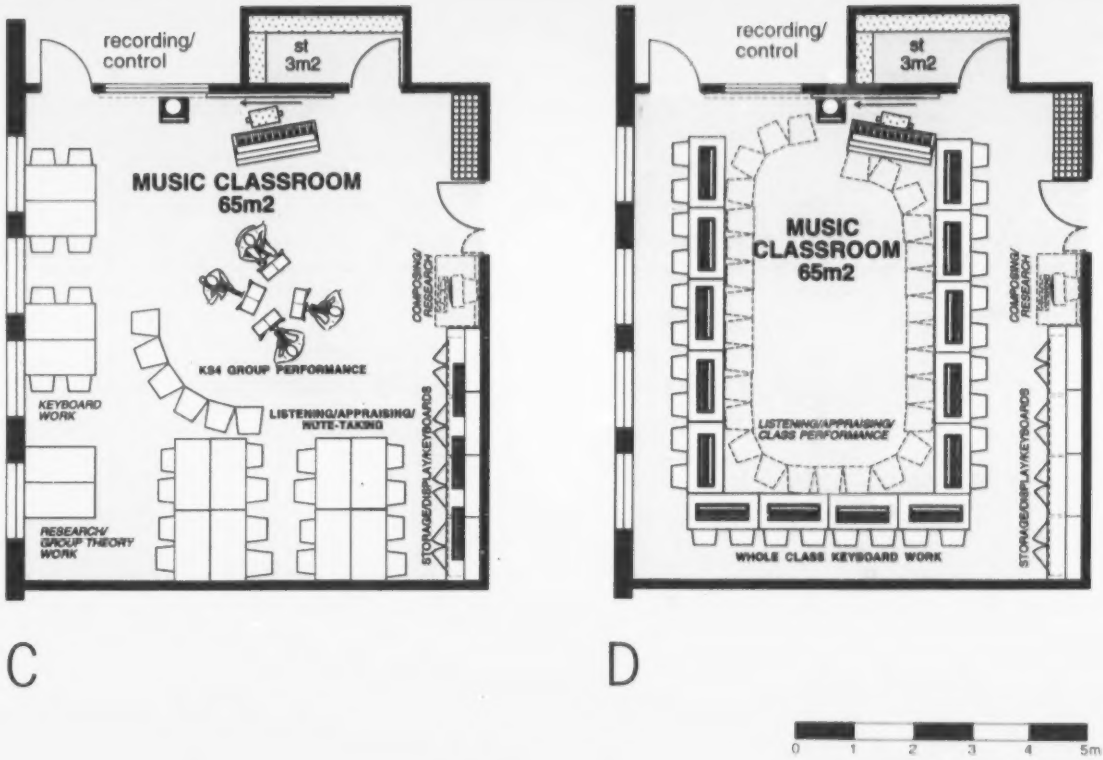

A Music Classroom of 65m² (Figure 2/3)

2.11 Four different room layouts are shown, A, B, C and D.

A. Half the class are working at a keyboard with the teacher observing and instructing from the end of each peninsula unit. This illustration assumes that pupils are working one to a keyboard and the remaining pupils are in group rooms. The layout could also work with a whole class sitting at the tables (one keyboard between two) or alternatively gathered for activities such as singing (chairs are shown dotted).

B. Chairs are brought to the centre of the room for listening to each others' performances or compositions, for whole class discussions or listening to recorded music. Pupils could also sit at the tables for small group discussion work or research.

C. A more formal performance takes place, probably in KS4. Pupils bring chairs to the centre of the room to watch and listen or they can takes notes sitting at the tables.

D. Tables are arranged in a circular or horseshoe layout for a whole class of pupils to use keyboards (powered from socket outlets located in the floor), listen to a recording (and be able to take notes), or take part in whole class composing. The teacher is assumed to be addressing the class from the teaching wall. Alternative seat positions are shown in front of the desks which enable pupils to sing or perform 'in a circle'.

Figure 2/3 C & D
65m² music classroom planned for a range of activities

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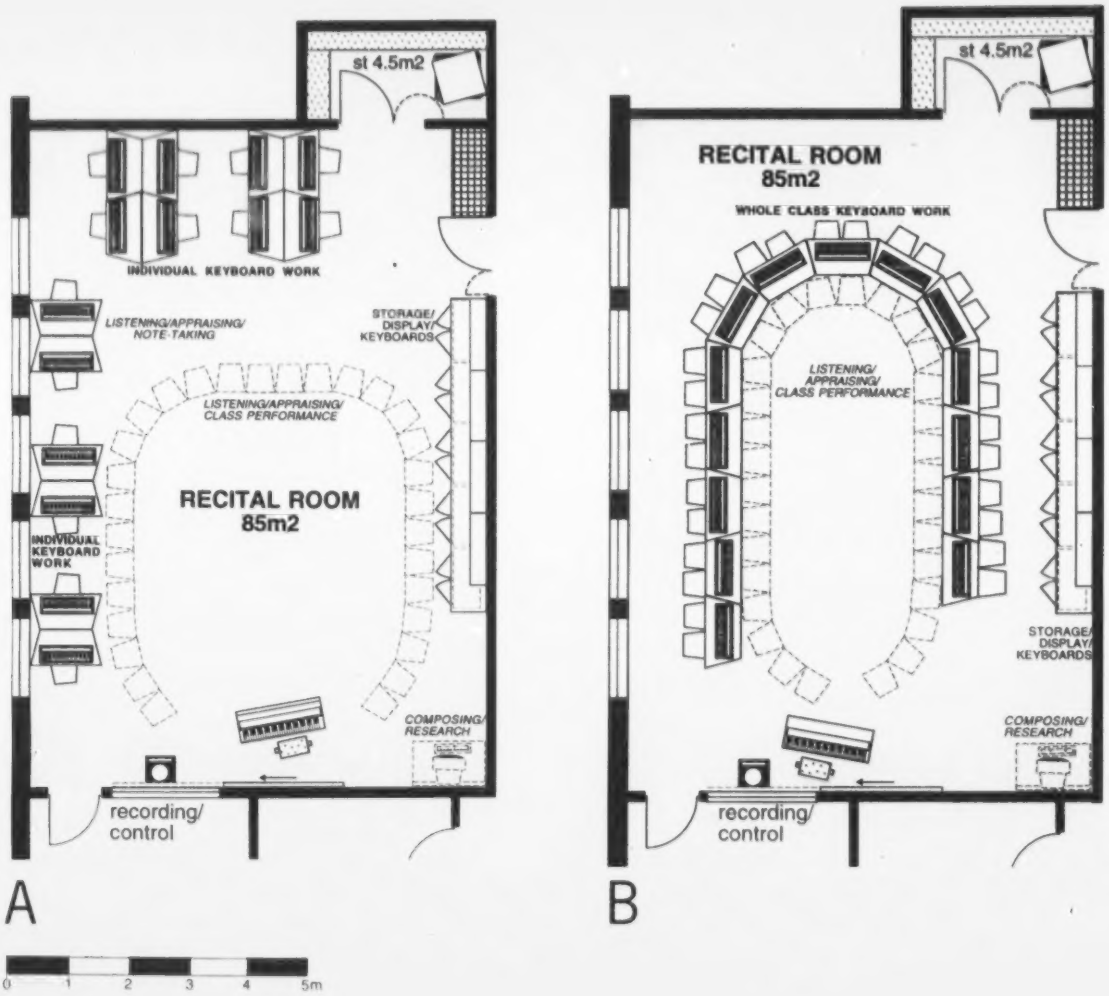


Figure 2/4 A & B
85m² music class/recital room planned for a range of activities

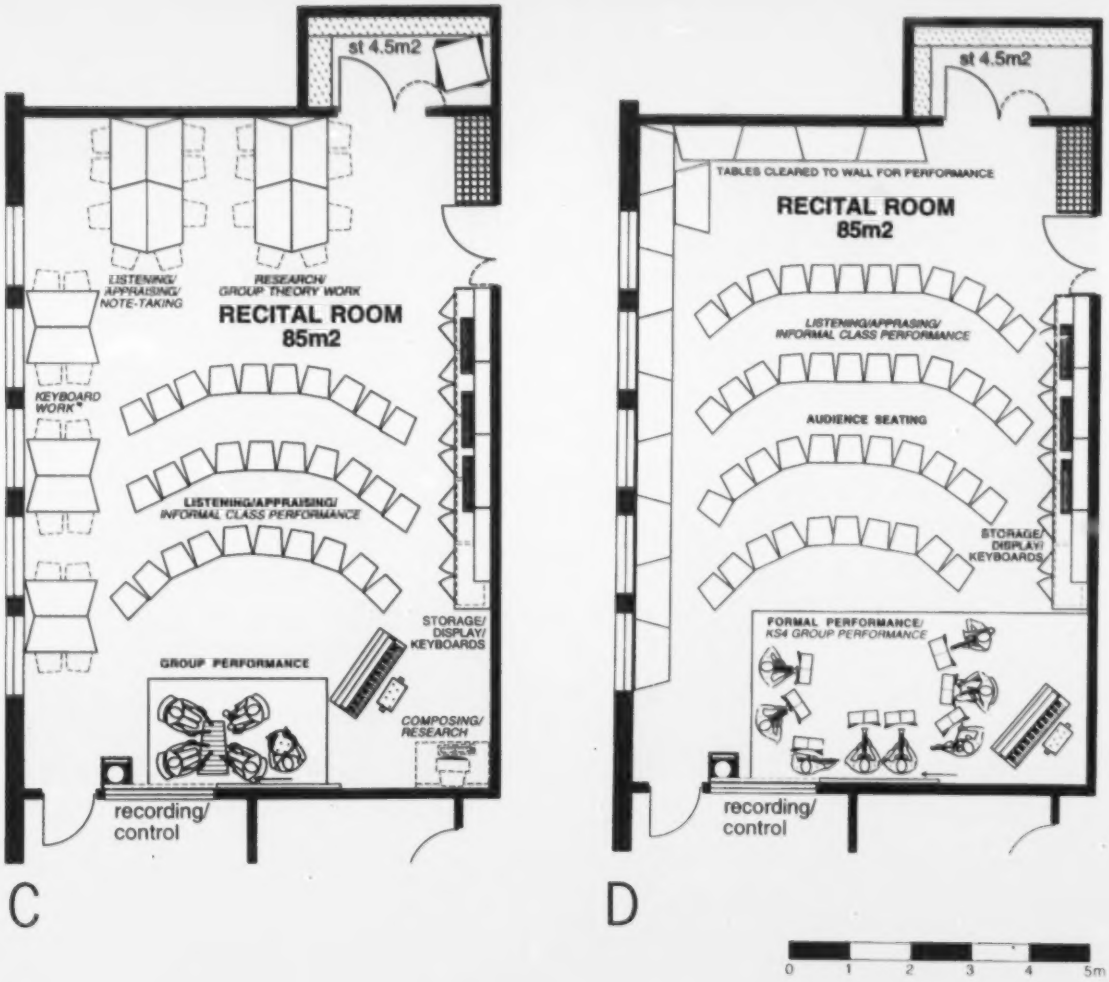
A Class/Recital Room of 85m² (Fig 2/4)

2.12 This room accommodates the same classroom activities, outlined in paragraph 2.1, as the smaller room. The basic elements of tables, side benching and a teaching wall are still present and most issues raised in the description of the 65m² classroom are relevant. However, it is assumed that the recital room has an additional function as a performance space with concerts and recitals given in front of a small audience, either as part of classwork or during extended curricular time.[3] The space will also be used for rehearsals.

2.13 The additional 20m² allows part of the floor area to be allocated to staging. Creating a stage can help to improve pupils' performing skills. A demountable system can be built in different formations or removed completely should it be used infrequently (see also paragraph 3.32, Section 3). Staging can be kept in one of the group rooms or store rooms or stacked in one corner of the room when not required. Performances in this space may vary from a soloist to a wind ensemble, the ability to re-arrange the staging enables the performance area to be used effectively. A one-and-a-half leaf door is shown into the store where bulky items such as staging may be kept.

Notes

[3] In a space of this volume (about 250m³) a brass instrument played forte would be uncomfortably loud, and a group of brass instruments would be even more uncomfortable. In such a situation, heavy drapes are a practical and effective method of reducing loudness. See Section 4.



2.14 Four possible arrangements are illustrated: A, B, C and D.

A A classroom situation with some pupils at keyboards and a free space available for singing 'in a circle', evaluation or performance. Staging is stored away.

B. Tables are arranged for whole class keyboard work. Chairs can be brought forward for singing 'in a circle'.

C. A group of five pupils is performing from a stage to the rest of the class.

D. The classroom tables are moved to the perimeter of the room to create a more formal performance space suitable for a small audience. It is worth noting that the trapezoidal tables shown here along the wall take up less wall space than the standard rectangular shape. The tables could alternatively be stacked in a store or group room.

Figure 2/4 C & D
85m² music class/recital room planned for a range of activities

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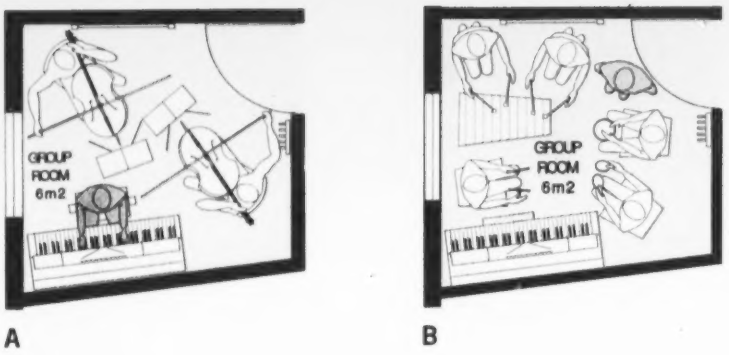
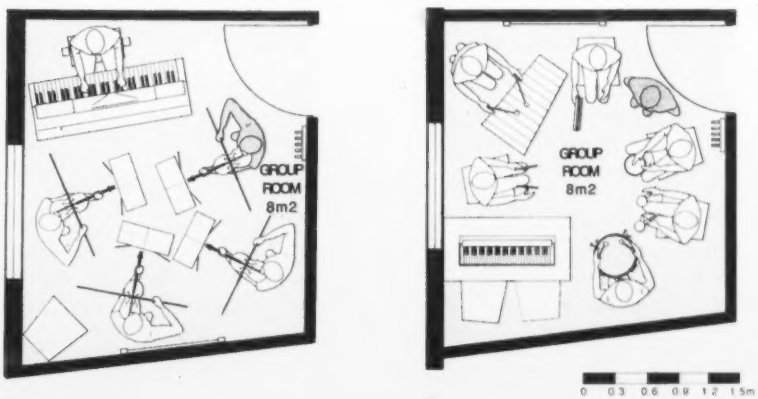
Figure 2/5
6m² group room
A: an instrumental lesson
B: small group composition work



A B

Figure 2/6
8m² group room
A: an instrumental lesson
B: small group composition work



A B

Supplementary Teaching Spaces

Group/Ensemble Rooms

2.15 While there may be group rooms primarily for composition work and an ensemble space designated as the base for instrumental teaching, these spaces are most effective if they are multi-functional.

2.16 Peripatetic lessons may be taken individually, or in groups of up to four. Individual pupils or groups also practise in their own time. Group sizes for class composition in KS3 vary widely but are not usually larger than six, KS4 pupils work in pairs or individually. Pupils learn a variety of instruments in most schools, including traditional orchestral, such as violin or flute, and contemporary band instruments. In class work, percussion will be used a good deal, although pupils will also play their own orchestral instruments.

2.17 There will be very little furniture in a group room, unless it serves a dual use as a store room or office. Typically there will be a few stacking chairs, music stands, a full length mirror for teaching the correct posture when playing and some coat hooks. In larger group rooms or the ensemble room there may be a table for a keyboard or a percussion instrument.

Size and Shape of Group/ Ensemble Rooms

2.18 The space requirements will be determined by the number of people using the room and the type of instrument being played. A drum kit and a piano are particularly space consuming. However, the space required for an instrument is as much determined by the loudness of sound. An intolerable volume of sound would make it undesirable for a drum kit to be played in the smallest group room. There is usually a piano

in the ensemble room and in at least one out of every four group rooms used by the instrumental teacher, for individual practice or as part of group composition work. One piano is often housed in the smallest group room leaving the larger spaces available if the piano is in use by one pupil. Composition groups, which may be larger (at KS3) than instrumental groups, tend to require less space per pupil because of their informality and the type of instruments being played.

2.19 A room for instrumental teaching and composing will generally be around **6-8m²**. About 6m² is large enough to accommodate a piano with up to three pupils taking part in an instrumental lesson, or up to five pupils playing a range of mainly percussion instruments as a composition exercise. A space of 8m² will allow for a piano alongside a group of three or four instrumentalists, or up to six in a typical composition group. An area of 4-6m² may be useful for some instrumental lessons and to practise, but is limited for composition work which is usually in larger groups. The stated areas do not include any storage.

2.20 If all the group rooms are at least 6m², they can accommodate most instrumental lessons and a variety of group formations for composition work. One or two spaces of at least 8m² will widen the range of possibilities. A suite of four group rooms, as described in Section 1, could therefore comprise two multi-purpose spaces of 6m² and two of 8m².

2.21 A larger room of **20-25m²** (often called an ensemble room) can be used for larger group rehearsals or performance as well as instrumental lessons in a more favourable acoustic environment. A room of 20m² can accommodate a piano and 8-10 pupils rehearsing. A room of 25m² will accommodate perhaps another 2 pupils, depending on instruments. A drum kit is often kept in the ensemble room and sometimes in the music classroom where it may be used as part of group composition work or as a teaching tool. Schools which have additional large instruments such as a gamelan or set of steel pans will need to consider how best to accommodate them within the area available.

2.22 In terms of room proportion, square plan forms should be avoided, and long narrow spaces are not conducive to interactive group work. Group rooms should incorporate at least one wall angled at between 5° and 10° to promote sound diffusion and preclude standing waves and flutter echoes (see Section 4 and Glossary II).

Group Room/Ensemble Room Layouts

2.23 Figures 2/5 and 2/6 show group rooms of 6m² and 8m² where pupils are engaged in either composing or instrumental lessons. A piano is shown in three of the spaces; in one of the 8m² rooms a table is shown as an alternative. The latter is intended mainly for keyboard playing but would also be useful as a work surface. A teacher is shown in each room (shaded grey), either playing an instrument or assisting/observing a group. The following points are notable:

- the door is located in the corner of the room to minimise wasted space;
- one wall is at an angle of 7° (see paragraph 2.22);
- in the smaller rooms, the piano is positioned against the wall to save space but in a way that allows the player to have eye contact with other instrumentalists;
- a mirror, used to assist musical posture, is shown;
- coat hooks are provided adjacent to the door;
- there is adequate space for each pupil to play an instrument without restriction and where applicable, to use a music stand. For stringed instruments, a fully extended bow is shown dotted.

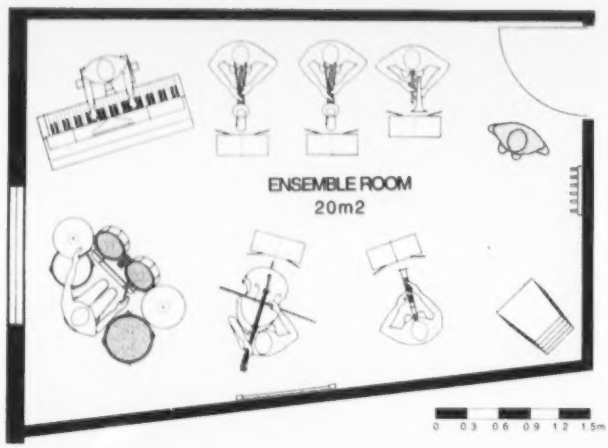
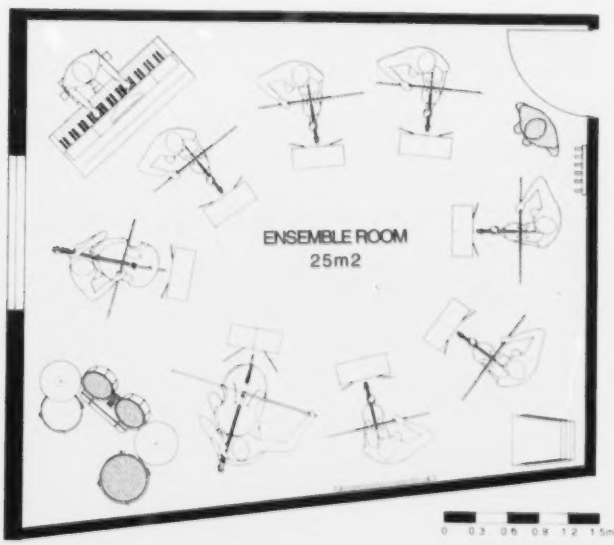


Figure 2/7
20m² ensemble room

2.24 Figure 2/7 and 2/8 show ensemble rooms of 20m² and 25m² respectively. In the smaller room a seven piece jazz band is performing and in the larger, a string ensemble group is playing. A piano and a drum kit, both of which are often kept permanently in the ensemble room, are shown in both examples. Most of the points made about the group rooms apply equally here; the angled wall, hooks by the door etc. Particular points to note about these spaces are:

- The piano is positioned to face into the room for better group interaction.
- A few chairs are shown (stacked). These can be used by instrumentalists or an audience.
- The drum kit, which can be very loud, is positioned as far away from the door as possible.
- The drum kit takes up space whether in use (as in the 20m² room) or not.

Figure 2/8
25m² ensemble room



Recording/Control Room

2.25 The recording of pupils' musical performances will often be part of the music curriculum. Recordings may be made as part of class teaching for feedback to pupils or they may be made for assessment purposes eg. at GCSE. Numbers will vary from a whole class to an individual. Recording may be made using simple recording equipment placed in the performance space itself but many schools choose to have a separate recording/control room which contains more sophisticated equipment allowing teachers to mix and control sounds. This room can also be used for music technology coursework, particularly in the sixth form.

2.26 Performances may take place in the music classroom, group room, ensemble room or school hall. There may be audio links to all these but if the key components of the recording equipment are mobile they can be taken to the performance space itself. Recording may be carried out by pupils or the teacher who may also demonstrate the procedure, mainly to KS4 or sixth form pupils; such groups are unlikely to exceed six.

2.27 The acoustic environment of a control room needs to be 'dead' to ensure good quality conditions for monitoring recordings over the loudspeakers (see paragraph 4.50).

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This can be achieved by providing acoustically absorbent surfaces. In order to ensure adequate sound insulation, the detail of doors, windows and observation panels should be carefully designed (refer to 'Acoustics' in Section 4).

A Recording/Control Room Layout

2.28 Figure 2/9 shows a recording/control room of 11m², located between two music classrooms and a group room. There are observation windows to all three spaces to allow for visual communication, particularly between those recording and those performing. A typical range of recording equipment, shown on a trolley, includes:

- mixer with in-built tape machine;
- amplifier (below the mixer);
- effects unit (below the mixer).

A computer with keyboard, to be used alongside the recording system for creating additional sounds, is also shown. A computer may also be used for digital recording. There are monitoring loudspeakers at high level.

2.29 The following points about the layout are useful to note.

- As the recording equipment is placed on a trolley, it can be moved to a position to suit the performance location. This also allows the equipment to be taken to a remote performance space such as the hall.
- The computer and keyboard are positioned on one of two runs of 750mm deep fixed benching which has tray storage beneath for keeping material such as tapes and disks. Tall shelf units provide additional storage.
- The equipment trolley can be positioned alongside the bench to enable computer and keyboard to be used in conjunction with the recording equipment.
- The computer screen is at right angles to the external window to avoid problems of daylight glare.

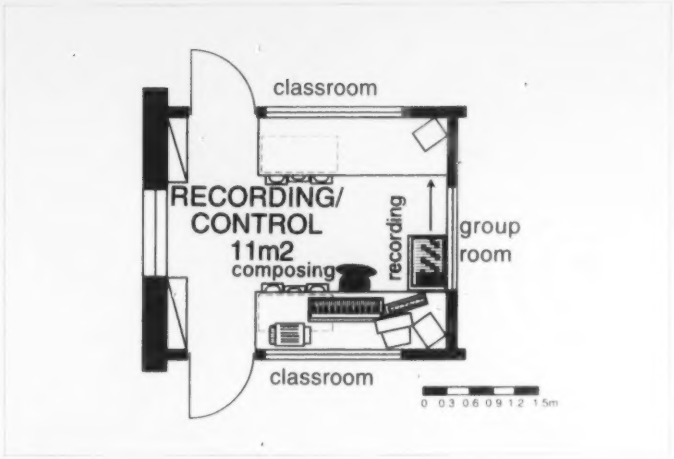

Figure 2/9
Recording/control room layout

- There is room for a small group of pupils to watch a demonstration.
- The room is accessible from both classrooms.

Storage

2.30 The range of items to be stored in a music suite can be broadly grouped thus:

- **reference material and work records** (worksheets, musical scores, tapes, compact discs, books and files);
- **shared equipment** (TV/video), likely to be on trolleys;
- **a range of instruments**. The department will have a basic stock and pupils' own instruments are brought in for extended curricular work and class lessons.

2.31 The method for storing these items will vary depending on the school's approach and whether there are separate store rooms. Some **reference material** is usually kept in the classroom where it can be easily accessed. School **instruments**, particularly percussion, which are used for classwork are often kept in the music room where they are easily reached and create an inspirational display. This local storage is allowed for in the teaching areas in Figure 1/2 and it is shown on the plans in Figures 2/3 and 2/4. In addition to this, there is a need for separate store rooms, such as a classroom store and instrument store.

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Classroom Store

2.32 This may house books, tapes, worksheets, and pupils' records.[4] Equipment such as a computer or video recorder will move between spaces but will probably have a parking place in a store room. Tables or screens may also be kept in here when a classroom is cleared for performances. Within an overall storage area of **0.3-0.4m²** per workplace (see Section 1), **0.1-0.2m²** per workplace is a useful guide to class storage. The upper end of the range may be appropriate, for example, in a small school or where staging is kept in the store room. The width of a classroom store should be sufficient to accommodate a trolley (for computer, keyboards etc.) in between shelving. A minimum door width of 900mm will allow a trolley to be manoeuvred easily; a one-and-a-half-leaf door may be preferable where screens are kept in the store.

Instrument Store

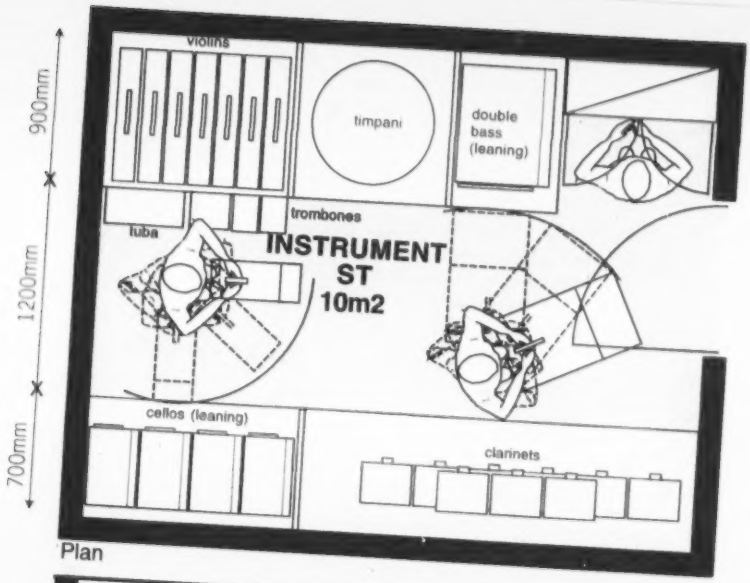
2.33 Instruments that are not used frequently and pupils' own instruments are usually kept in a separate store room. This needs to be secure but accessible to pupils for peripatetic lessons (a combination lock is sometimes used). The size of an instrument store will depend on the number of pupils taking up peripatetic lessons, the range of instruments played, how long pupils leave their instruments at the school and the nature of the school's own instrument stock. Each of these factors varies so much between schools, that it is difficult to give specific guidance on quantitative storage requirements. The figure of 0.3-0.4m² per workplace referred to above includes instrument storage but is approximate. The shape of a store should allow for large instruments such as double basses to be reached easily. The position and swing of the door should not obstruct shelving. Further detail on storage methods is given in Section 3.

2.34 Figure 2/10 shows a store housing a range of instruments. Some of these will be from the school instrument stock and others will change daily according to the range of instrumental lessons taking place. This store shows about 70 instruments and may be applicable to a medium sized school (about 900 pupils, say). General points to note about the arrangement shown here are as follows:

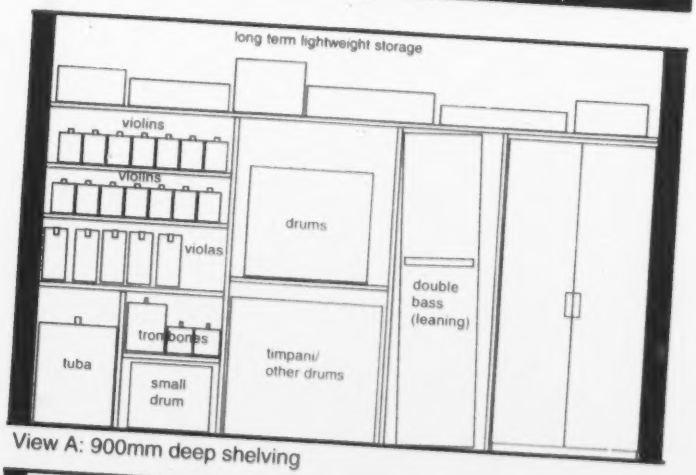
- The horizontal distance between shelving (1200mm) allows pupils to manoeuvre instruments comfortably.
- There are two depths of shelving: 900mm for long instruments and 700mm for smaller instruments such as flutes.
- Instruments longer than 900mm are placed at the back of the store room where they cause least obstruction.
- Instruments are stored at a height that is easily reached ie. below 1700mm. Smaller instruments are kept around eye height, heavy instruments around waist level and instruments longer than 900mm are generally at low level. Space above 1700mm can be used for longer term lightweight storage.
- Deeper shelves (900mm) are fixed but the shallower ones are adjustable to allow for changing instrumental stock (see Section 3).
- Vertical divisions provide for upright storage of cellos, double basses and guitars. The cellos are not stored directly opposite the double basses as these are the most difficult to manoeuvre. The double basses are nearest to the door.
- A shallow cupboard housing items which require only occasional access is positioned next to the door.
- The minimum vertical distance between shelves is 300mm to give pupils enough space to retrieve instruments safely.

Notes

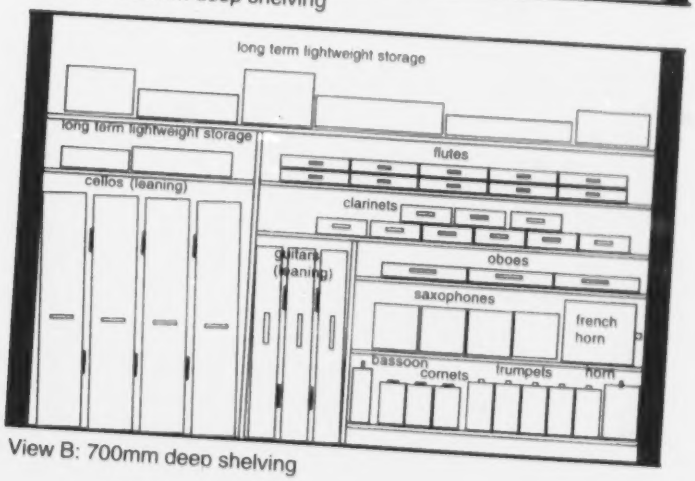
[4] Sometimes teachers' personal reference material and work records are kept in a secure store or in a staff office.



Plan



View A: 900mm deep shelving



View B: 700mm deep shelving

Figure 2/10
Instrument store: plan and elevations

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Section 3: Furniture

Furniture is an important consideration when designing spaces which need to adapt to the various demands of the curriculum. This section looks at ways of achieving flexibility through the appropriate choice and utilisation of furniture.

3.1 Furniture can become a resource in itself if used imaginatively. For example, a mobile storage unit can provide an additional work surface, either singly or as part of a run of units. A suite of music rooms becomes more unified and interchangeable if the same type of furniture is used throughout. Resources taken from a store room on a tray may be placed on a trolley, moved to an underbench tray unit, and moved again to another room in the music suite.

3.2 It is strongly recommended that furniture should be built to the strength and stability tests in BS 4875[1] and 5873.[2] This ensures that furniture meets the strength and stability requirements of a school environment. The publication 'Educational Furniture Database' explains the background to the British Standards for school furniture.[3]

Benching

3.3 Side benching may be at sitting or standing height; recommended heights are 700mm for sitting and 850mm for standing. A sitting height bench provides an additional work surface which, in music, may be used for keyboard playing. A standing height bench can also provide a worksurface for pupils to stand and play keyboards. It is worth noting that there is more storage capacity beneath a standing height bench (see paragraph 3.19).

3.4 The depth of side benching is usually 600mm but this does not allow pupils to sit in front of cupboards which are placed permanently under the bench. Therefore, a sitting height bench should either be deep enough (700-750mm) to allow pupils to sit in front of the cupboards, have knee holes beneath to allow pupils to sit between the cupboards or have mobile storage which can be moved away if necessary. This is not a problem with the higher bench when pupils are standing.

3.5 Benching can be a fixed worktop or made up from a series of loose tables. The latter may be more flexible but any fixed shelving above is not advisable (see 'Shelving', paragraph 3.21).

Tables

3.6 The tables in a music room need to cater for a variety of activities and should be reasonably lightweight to allow them to be re-organised easily. The layouts in Section 2 show some of the possible arrangements: in groups for note-taking or group discussion work, in a horseshoe arrangement mainly for whole class instrumental work or cleared away completely for a performance. The most typical general table surface is a rectangle of 1200 x 600mm. An alternative is the trapezoidal table with maximum plan dimensions of 1200 x 600mm. Trapezoidal tables offer several advantages, including the opportunity for basic wire management (see paragraph 3.9) and the ease with which they can be arranged in a curve. However, they provide a smaller surface area than an equivalent rectangular table and those with non-standard angles tend to be more costly (Figure 3/1a shows the non-standard 15° table used in the plans in Section 2 – a 30° table is standard). Nominal working height at a table is 700mm, but it may be worth considering that activities such as keyboard playing can be undertaken by players standing at benching, where the working height may be 850mm.

3.7 Tables are available in a variety of frame shapes, some of which are illustrated in Figure 3/1. Four legged frames available with either rectangular or trapezoidal tops (Figure 3/1a) are generally the most common – and often the cheapest. A stackable version is available which has one projecting leg (this can be limiting when arranging groups of tables). A school may wish to consider a cantilever or 'C' frame which when arranged in a long line allows pupils to sit at any point along the table

Notes

[1] BS 4875: Strength and Stability of Furniture, BSI 1985.
[2] BS 5873: Educational Furniture, BSI 1980.
[3] Educational Furniture Database (Broadsheet 31), DfE 1994.

without the restrictions of 2 front legs (see Figure 3/1b). This means that for the occasional full class lesson of keyboard or evaluation activities, it may be possible for 2 tables to accommodate 5 pupils, rather than 4. The extra expense of an individual 'C' framed table may, therefore, be offset by purchasing fewer tables and releasing floor space, particularly in a department where chair-based activities are more frequent. 'C' frame tables can also incorporate additional features such as a wire management tray which is particularly useful for computers (see paragraph 3.10). The 'I' frame table (Figure 3/1c) has similar characteristics; both types tend to be heavier than the standard four legged frame.

3.8 Tables tops are generally made from plastic laminate over a manufactured board core. For a subject such as music where tables will be re-arranged frequently and rely on standing closely together (particularly for keyboard work), wooden or firmly applied plastic edging is advisable to avoid splintering or damage from knocking.

Servicing Tables

3.9 Where tables are used for keyboard work, there will be cables running between socket outlet and keyboard.[4] The way in which tables are organised in a space can be used to minimise trailing cables. For example, some of the layouts in Section 2 show groupings of up to 4 standard classroom tables in a peninsular arrangement with keyboards serviced from the wall. In this arrangement, cables lie on top of the tables. The design of tables can also be used for creating simple forms of wire management. In Section 2, pairs of trapezoidal tables are shown abutting the wall in such a way that a void is is created, providing a useful gathering place for cables. This means that no excess cable sits on the table, leaving it less cluttered.

3.10 There are various types of table which offer wire management facilities (ie. some method of containing cables and keeping them tidy, often a tray at the back of the table). There are also serviced tables which carry power in a service spine into which equipment can be plugged. If serviced tables are 'daisy chained' (where a table is serviced via a socket outlet incorporated into an adjacent table) they should be rigidly linked together in accordance with BS 6396.[5] This requirement prevents a single table being moved within the 'chain' and breaking the power supply to other serviced equipment. Schools must consider whether a sophisticated table system meets their curricular and budgetary requirements. It is worth bearing in mind that the quantity of cabling required to service a keyboard is far less than for a computer which may justify a more sophisticated wire management system.

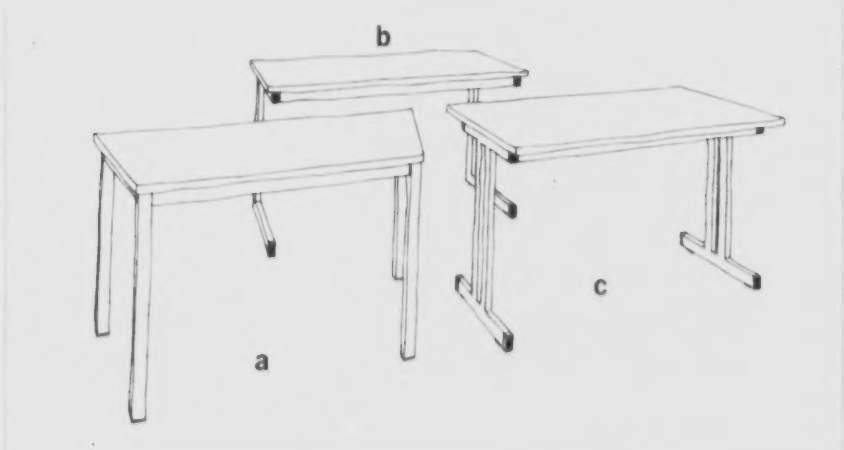


Figure 3/1
Tables and table frames
a: four legged trapezoidal
b: rectangular 'C' frame
c: retangular 'I' frame

Notes

[4] Batteries are less often used and are more expensive to run.
[5] BS 6396: Specification for electrical systems in office furniture and safety screens, BSI 1989.

Figure 3/2
Computer table

Computer Tables

3.11 Schools may wish to consider a specialist table for IT. The table (or trolley) should ideally contain a cable tray, or similar system for wire management, to prevent trailing leads and cables from forming a hazard. Computer tables are usually available in 1000, 1200, 1500 and 1800mm widths. A useful rule of thumb is to allow 1000-1200mm for a single station with 1 (or occasionally 2) users, 1500mm for a single station with 2 users and 1800mm for 2 stations with 2 users.

3.12 Allowing for a working height of 700mm, the work surface and front rail should have a total thickness of no more than 75mm to enable thigh clearance. The work surface should allow for the flexible arrangement of IT equipment and be deep enough to allow the keyboard to be placed in front of the VDU and for pupils to sit at least 600mm away from the screen. A depth of 750mm is usually sufficient.

3.13 A computer table with castors (a trolley) may be useful where computers are shared between a number of spaces in a music suite; smaller tables are often more manoeuvrable. It is important that the castors are lockable to ensure stability.

3.14 Where a computer is used alongside a music keyboard, a table depth of 800mm may be more appropriate (see Figure 3/2). Specialist trolleys, designed to accommodate both a musical keyboard and associated computer hardware, sometimes incorporate a sliding shelf for a music keyboard. This shelf should be at an appropriate height for keyboard playing and of robust construction. It should be possible to lock the shelf – which is at sitting height – in the extended position.

Seating

3.15 For general activities, stackable plastic moulded chairs are useful as they are inexpensive, easy to clean and lightweight. Chairs with an adjustable back and seat are preferable when sitting at a computer; they enable adequate postural clearance for pupils of varying sizes and allow pupils to adjust their eyeline to the correct position in relation to the computer screen. Chairs with adjustable seats can also be useful to ensure pupils are at the correct height for playing a keyboard or certain percussion instruments. If used in conjunction with a mobile computer table, adjustable chairs should have castors to enable them to be moved from room to room with the trolley.

3.16 In recital rooms and larger performance spaces, seats which are lightly upholstered[6] are recommended to minimise variation of acoustic conditions with occupancy. Standard plastic moulded chairs are available with an upholstered pad at the seat and back. Stools are often used by double bass players; they are more comfortable with a shaped wooden or moulded plastic seat and they must have a footrest. Piano stools in single or double size, which can be individually adjusted, are generally used at a piano. For playing the guitar, a footrest allows the player to raise one knee to a comfortable position, beneath the instrument.

Storage and Display in the Music Classroom

3.17 Display is an important part of any classroom and both horizontal and vertical display provides visual stimulation and information. Display and storage in music rooms are usually interlinked; instruments may be stored in the classroom on open shelves where they also help to create an appropriate musical atmosphere. Various methods of providing storage and display are described here, some of these are illustrated in Figure 3/3.

Underbench Storage

3.18 Floor standing storage units, often positioned beneath a worktop, can be mobile or fixed. Units on castors are useful for occasions when pupils need to sit at a 600mm deep sitting height side bench as they can be temporarily moved elsewhere. Where mobile storage units are sited under standing height benches (as in Figure 3/3) they can be correspondingly higher. Moving these into the centre of the room and against clusters of sitting height tables can provide some discrete space division. Mobile storage units are slightly more expensive than those fixed beneath the bench because they have castors and a top but the fixing cost is saved. The overall cost needs to be considered alongside the possible advantages of flexibility in a classroom layout within the constraints of the F&E budget.

3.19 The storage of keyboards is a major consideration in a classroom. In some cases they are left permanently on a side bench but many teachers prefer to put them away in a storeroom or classroom cupboard when they are not in use. A typical 1000 x 480mm wide cupboard beneath a standing height bench can accommodate three keyboards (one per shelf). A unit below a sitting height bench will accommodate two keyboards. This assumes a distance of at least 200mm between shelves to allow for an average sized keyboard and hand clearance.

3.20 Underbench units are useful for storing other resources in teaching and non-teaching spaces. They can be supplied either with shelves or trays which can accommodate worksheets, scores and small percussion instruments such as triangles or castanets. Deep trays are particularly useful for instruments. Trays have the advantage that they slide out allowing resources to be accessed easily; they can also be removed completely allowing small percussion instruments to be carried to wherever they are needed. Cupboards with adjustable shelves may be more useful for tall instruments. If both shelf and tray units are provided, a wide range of resources can be housed. A small plan chest may be considered for storing display posters (up to A2 size).

Shelving

3.21 Shelving may be used in the classroom for all types of resources including instruments. On all the classroom layouts in Section 2 and in Figure 3/3, shelving is shown above a fixed worktop. It is inadvisable to have shelving above unfixed furniture which may be removed, as it can then become a hazard, often being at head height. A nominal depth of 250mm is considered

Notes

[6] Upholstery must have an appropriate level of fire resistance, see Building Bulletin 7: Fire and the Design of Educational Buildings, HMSO 1992.

appropriate for general classroom shelves which may be fixed or adjustable. Figure 3/3 shows two adjustable systems, both based on a cantilevered bracket which can be slotted into metal uprights at frequent intervals. In Figures 3/3a and 3/3b, the uprights are fixed to the wall but in Figure 3/3c, they hang from any point along the length of a shaped metal section fixed horizontally to the wall at high level (rather like a picture rail). This is a very flexible system which can also be used to support display boards and whiteboards (see paragraph 3.25). It may not be suitable on very lightweight walls. In both these systems, the maximum centres of uprights is usually 700mm, to allow a reasonable span for a typical 19mm thick shelf.

Storing Headphones

3.22 Headphones are often kept close to the tables or benches where keyboards will be used, allowing them to be accessed easily. Figure 3/3 shows three possible methods of supporting them.

Figure 3/3a. A simple and inexpensive method whereby headphones are hung on robust hooks fixed to the underside of shelving. The headphones are easy to reach but they do place some limitations on the size of objects on the shelf below them.

Figure 3/3b. Headphones are hung on hooks which are incorporated into a continuous dado rail. This arrangement is particularly appropriate where all keyboards are placed on perimeter benching.

Figure 3/3c. Headphones hang on hooks which are firmly screwed to a panel which can be hung from any point along a horizontal metal rail (described in paragraph 3.21). Panels can be positioned to suit the room layout and are best located away from circulation routes.

Other Storage Units

3.23 Tall storage units or 'wardrobes' as they are sometimes known can provide a good level of storage space which is particularly useful where storeroom area is minimal. These units are available with trays or shelves or a combination of the two. A unit about 1.8-2.1m high and 1m wide will house 6-7 keyboards, providing there are enough shelves; units usually come with more space between shelves than is necessary for keyboards. As congestion can occur around a tall unit if all pupils are getting keyboards out at the same time, the use of lower units containing fewer keyboards may be more appropriate. The stability of these tall units should be considered and the relevant strength and stability tests adhered to.

3.24 Wall cupboards can be a more secure alternative to open shelving.[7] Wall cupboards are generally positioned at eye level, making smaller resources such as books and scores easy to access and to organise.

Whiteboards and Display Boards

3.25 Whiteboards and display boards can be wall fixed. Alternatively, the top hung system described in paragraph 3.21 can be used. Although more expensive than fixed boards, this system does allow boards to be repositioned by the teacher. Some schools may find a mobile whiteboard useful, particularly where pupil sightlines are a problem. For music lessons, it is important to have a staved board in addition to plain. There may be two wall mounted boards or both versions on a 'roller' board (mobile or wall mounted).

3.26 Display boards offset by a small angle from the wall (eg. 5°) can help to modulate a large wall surface and break up sound waves (see 'Acoustics', Section 4). Some panels can also increase the acoustic absorption of the wall surface, depending on their material (for example mineral wool foam with a fabric finish).

Notes

[7] However, open shelving holding objects generally provides more sound diffusion than closed cupboards (see 'Acoustics', Section 4).

30

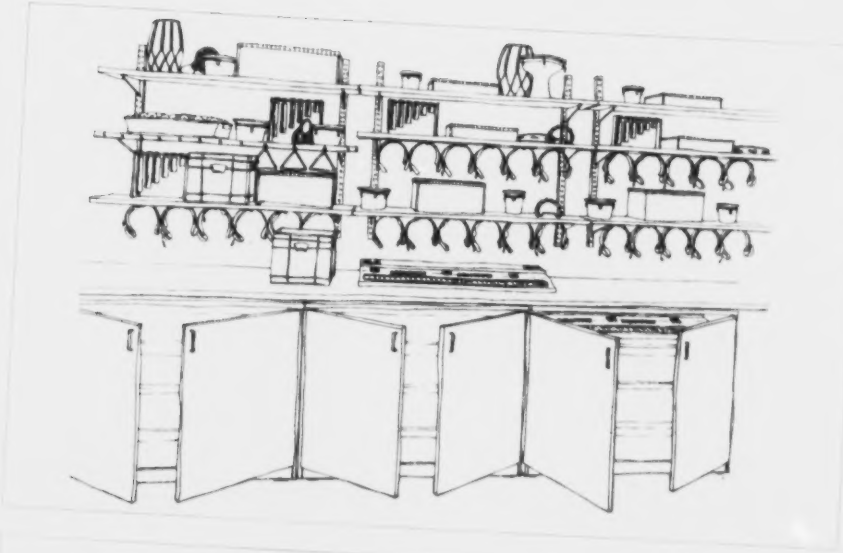


Figure 3/3a
Shelving with headphones attached under shelf

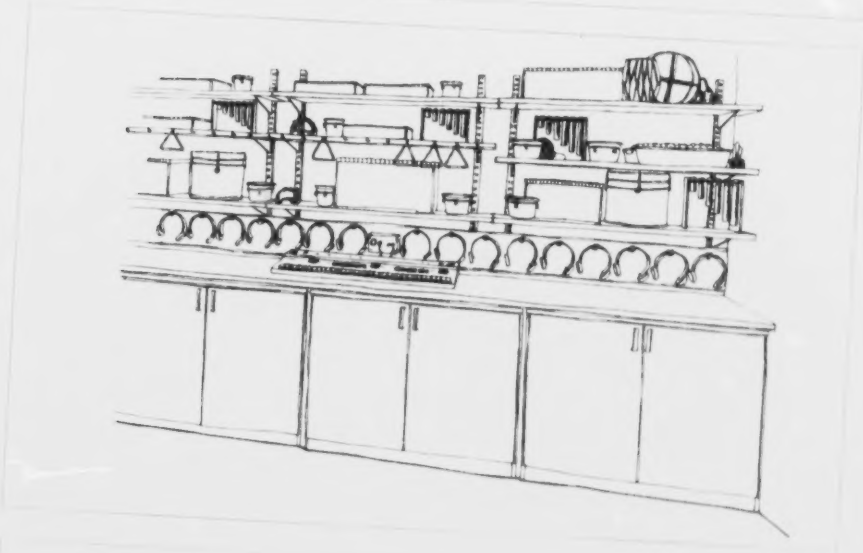


Figure 3/3b
Shelving with headphones on hooks at dado level

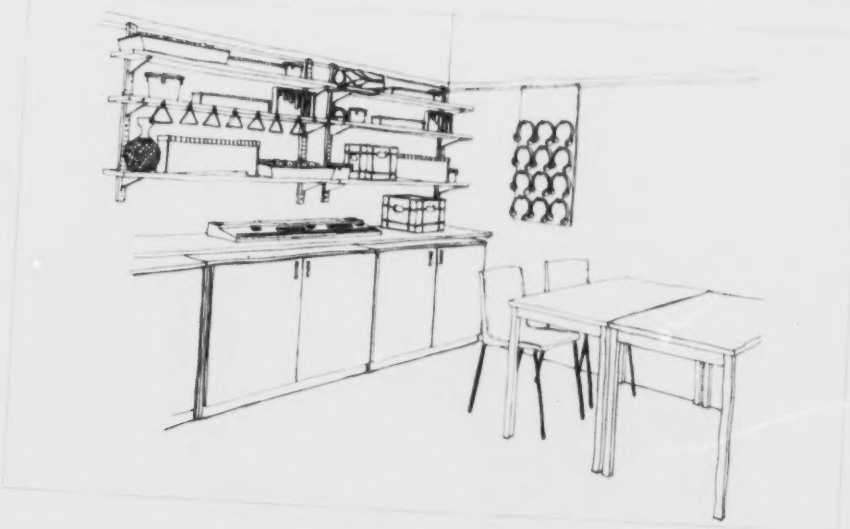


Figure 3/3c
Shelving with headphones on movable wall board

Store Room Shelving

3.27 Full height shelving is likely to be used in the instrument or class store. Store room shelves are generally deeper than those in the classroom; a depth of around 350mm will accommodate standard trays as well as keyboards. There are a number of shelving systems available with varying levels of flexibility. Fixed shelving can be supported either by side battens or by cantilevered brackets which allow for longer runs of uninterrupted shelving. An adjustable system provides greater flexibility; two of the most typical systems are shown here in a classroom store (Figure 3/4 a & b).

3.28 **Side supported shelving** (Figure 3/4a). A free standing timber system where re-locatable pegs allow shelves to be adjusted vertically. The frame is usually fixed to the wall for additional stability. Some advantages of this system are:

- it is easy to install;
- relocatable and;
- rigid.

Some disadvantages are:

- the shelf width (span) is determined by the vertical supports;
- side panels can make it more difficult to access certain resources.

3.29 **Cantilevered brackets** (Figure 3/4b). This system, also illustrated in Figure 3/3a&b, is a versatile system providing the following advantages:

- it has both horizontal and vertical variability;[8]
- shelf widths are not standardised and can vary;
- an uninterrupted run of shelving can be achieved making access easier.

The disadvantages are:

- shelf depth is limited by the cantilevered support (generally 700mm max.);
- uprights have to be fixed to the wall at frequent intervals.

3.30 Where instruments are being stored, the storage system should have the following characteristics (in order of priority):

- Strength - instruments can be heavy;
- Flexibility - the number and type of instruments in a school can vary over time.

Although instruments are very varied in size and shape, storage systems do not have to be sophisticated. The instrument store described in Section 2 (Figure 2/10) shows two adjustable systems: cantilevered brackets and side supported shelving. The

Notes

[8] This advantage can be seen by comparing Figures 3/4a&b. For example in Figure 3/4b shelving has been introduced alongside a tall object (the microphone) providing optimum storage.

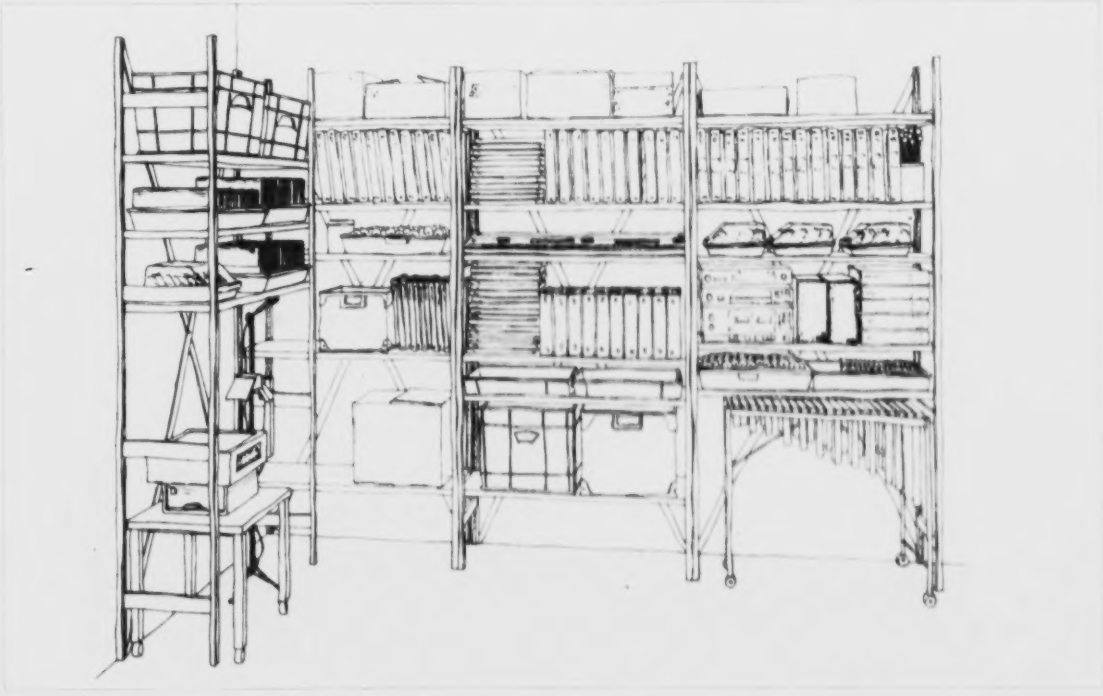


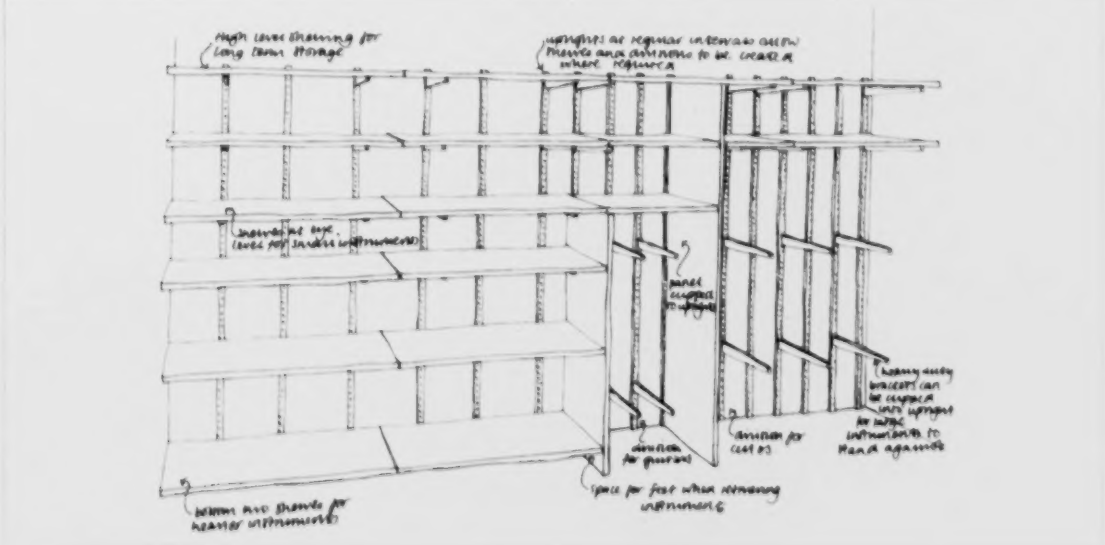
Figure 3/4a
Classwork storage: side supported shelves

Figure 3/4b
Classwork storage: shelving on cantilevered brackets

cantilevered system (as figure 3/4b) is used along one wall for the 700mm deep shelving where there are more horizontal divisions. A side support system is used for the 900mm shelves where shelf depth makes a cantilevered system inappropriate. Brackets that fit into holes in the fixed vertical boards can be relocated, giving vertical flexibility. A similar system to that shown in Figure 3/4a could also be used in this situation.

3.31 Figure 3/5 shows part of the instrument store where 700mm deep shelves are supported by cantilevered brackets. It illustrates how the versatility of the system can be used to good effect when storing instruments. Metal uprights are fixed along the whole length of one wall; one half at 150mm centres to allow support for individual tall instruments and the other half at 300mm centres to create a high level of flexibility. Two sheets of manufactured board, securely located against the metal uprights, provide vertical divisions for tall instruments such as cellos and guitars. Points of interest are noted on the drawing.

Figure 3/5
Instrument store: adjustable shelving system (700mm deep shelves)



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Staging Systems

3.32 A stage may be created from a series of modular wooden staging blocks but these are fairly heavy to move and difficult to store. For this reason there are now many types of demountable staging systems available to schools which are lightweight, easy to assemble and take up less storage space. However, they do require teaching time to assemble. The advantage of demountable staging systems is that various configurations and sizes can be created to suit different types of performances; the same system can be used for seating, if appropriate. The basic module should be small enough to ensure a good variety of arrangements but not so small that setting up takes a long time. For simplicity, it is advisable to buy components in a limited number of sizes and heights. Some examples of staging arrangements are shown in Section 2 (Figure 2/4).

Screening

3.33 Furniture screens are a useful way of temporarily dividing up a space, and they can help to create a different 'atmosphere' particularly when performance activities are carried out. Figure 3/6 shows the 85m² space described in Section 2 arranged for a small group performing to the class. Classroom tables are left in place and the performance area is defined by loose screens which can be kept at the back of the room or in a store when not in use. However, it is important to note that these screens do not provide acoustic separation.

3.34 Furniture screens come in a number of dimensions and finishes with differing connection systems. Some screening systems allow for a number of angled formations which have the advantage of fitting more 'snugly' around furniture or structures. The finish of some screens is designed to be acoustically absorbent and this can be useful in a music classroom. A screen with a soft surface on one side and a hard reflective surface on the other may provide additional flexibility. Screens can also be used as pinboarding which can be useful for display purposes. Care must be taken to choose screens that do not present a tripping hazard when located in the centre of a room.

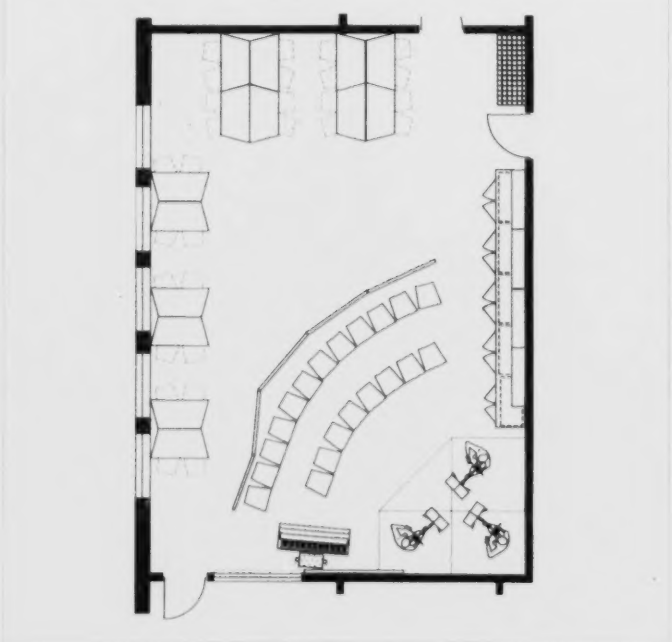
3.35 To divide a space where a degree of sound separation is required between activities, it would be necessary to use floor to ceiling screens which can be acoustically sealed - these are called movable or operable walls. Good quality movable walls are effective room dividers, but the cost[9] prohibits general use in schools. Curtains can also be used to divide a space but only visually, not acoustically (see Case Study 3, Section 5). However, perimeter curtains in the form of heavy drapes enable the room acoustic to be varied to suit the prevailing conditions of use.[10] The use of drapes in music spaces is illustrated in Section 4: Applications of Principles and the effect is discussed further in paragraph 5.9, Section 5.

Notes

[9] As the cost of these movable walls is high, the need for them should be carefully assessed, and the likely frequency of use considered.

[10] See also paragraph 2.12 footnote 3.

Figure 3/6
Recital room with screening for small group performance



Section 4: Services and Environmental Design

This section provides an overview of the main considerations for services design in music spaces. Any services installation must comply with the relevant statutory requirements including the School Premises Regulations[1] which prescribe minimum standards for environmental services. There are also a number of advisory documents, in particular Design Note 17.[2] Others are listed in this section and in the Bibliography.

4.1 As the facilities of the music department are often used by the school and the community outside school hours, the zoning of heating and security systems may be desirable particularly for suited accommodation.

4.2 It is worthwhile producing wall elevations of each music space early in the design process. These can be used to ensure co-ordination between service outlets, furniture, heating appliances, doors and windows. In almost all cases it is advisable to seek specialist advice when designing new or adapting existing music accommodation.

Electricity

4.3 Every electrical installation should comply with the IEE[3] wiring regulations. In a music suite the main electrical needs stem from the use of electronic keyboards and recording pupils' musical performances. The following can be used as a guide to the requirements for each room type but schools should consider their particular needs. In all spaces, it is important that outlet positions are chosen to avoid the hazard of trailing cables.

Music Classroom

4.4 The need will vary depending on teaching style and in particular the use of electronic keyboards; for a typical class of 30 pupils, there may be 16 twin socket outlets around the room for pupil use and a further six twin socket outlets at the teaching base for hi fi systems, computer, keyboard etc. In the main part of the space, most outlets are likely to be around the perimeter above worktop height but in a new building (or an adaptation where construction allows) it may be advisable to install some floor mounted outlets to allow keyboards to be used in the central area without having long lengths of cable. Tables should always be placed close behind a floor mounted socket to prevent cables being damaged.

4.5 Electronic keyboards require a low voltage (LV) supply and this is either provided by plugs with integral transformers or by a permanent low voltage installation. The size of LV plugs needs to be borne in mind when designing floor boxes for socket outlets.

4.6 Keyboards should either be serviced directly from a wall or floor socket in the ways described or via a serviced table. Loose extension leads should be avoided. Serviced tables usually come with a 2m lead which may be spiralled cable. Socket outlets on serviced tables will be fused at the socket with an appropriate fuse rating.

4.7 Each classroom should consider having a main control switch near to the teacher's base, controlling power to every keyboard socket outlet in the classroom except those controlling the teacher's equipment.

Group Rooms/Ensemble Rooms

4.8 In each group room at least two twin socket outlets on opposite walls are likely to be required. In order to maintain sound insulation back to back recessed socket outlets should be avoided.

Recording/Control Room

4.9 This will depend on the system used but about eight twin socket outlets located close to the console should be sufficient.

Notes

[1] The Education (School Premises) Regulations 1996.

[2] In this document Design Note 17 refers to the latest revision due to be published as a Building Bulletin in 1997.

[3] Regulations for Electrical Installations: IEE Regulations 1991.

Audio Systems

4.10 It is important that recordings are of a reasonable quality not only for assessment purposes but also to give valuable feedback to pupils. Recordings may be made with simple equipment in the performance space itself but there may be a separate recording/control room (see Section 2) with a mixing console and audio links to all or some of the spaces where performances may take place. Where a recording system is to be installed, it is advisable to involve a specialist designer or manufacturer early in the design process to ensure that the installation suits the particular requirements of the school.

4.11 Terminal boxes in the control room and performance space are generally mounted above bench height and should be positioned to avoid trailing leads. If there is a viewing window in the classroom, an ideal location for the terminal boxes is just beneath it. The location and detailing of walls and doors to a control room must be carefully considered (see paragraphs 4.24-4.32).

4.12 For playing recorded music in the main teaching space, there are usually two loudspeakers. If a greater choice of teacher position is desired, four loudspeaker outlets may be provided. A good position is at high level near the room corners. Speaker terminal sockets should be mounted in the area of the teaching 'wall' and out of normal reach. If loudspeakers are also linked to the control room, recorded music can be played back to a class.

Acoustics

4.13 In schools, achieving acoustic variability is a priority, because of the diversity of teaching and learning activities. The acoustic environment of a music space should be good enough to allow pupils to appreciate fully their own and others' playing whether they are listening to and appraising a performance or composing. It is therefore important to give priority to acoustic matters at an early stage in the design process when it is advisable to consider seeking the advice of an acoustic consultant.

4.14 Design Note 17 (DN 17) gives the recommended acoustic criteria for new school buildings. Other publications (see Bibliography) provide more detailed guidance. It is therefore more appropriate to cover acoustic design in general terms in this publication. This section provides a checklist of the main points to consider. There are two main aspects to a successful acoustic environment for a room where music is being played:

- the sound insulation of the space from other sources of sound that could cause disturbance;
- the quality of sound within that space.

These aspects require different design solutions and are discussed separately.

Sound Insulation

4.15 Sounds that may cause disturbance to the receiving room (a music class/practice room) include:

- music from other spaces;
- other teaching activities (eg. design and technology workshop);
- people movement (eg. corridor);
- playground activities;
- external noise such as traffic;
- building plant noise (eg. heating or ventilation systems).

4.16 The level of sound and possible disturbance from other music spaces will vary depending on the instruments being played (eg. a drum kit would be hard to ignore) but it is difficult to organise the use of spaces to take this fully into account without loss of flexibility.

4.17 The degree to which a non-musical sound is disturbing can depend on the nature of the sound. For example, a characterless noise from mechanical ventilation may be acceptable whereas an

intermittent sound from passing trains may not be. Continuous characterless noise can sometimes provide useful masking of sound from adjacent rooms where music-making occurs. However, the masking sound should not be so loud as to be distracting in itself.[4] Ideally, to appreciate the full dynamic range of the music, background noise levels should be near inaudibility. However, this is very demanding on sound insulation between spaces and is not usually feasible in practice. The highest level of sound insulation is required when recording. An appropriate level of sound insulation can be achieved through a combination of planning and construction. This is discussed below.

Planning

4.18 At the design stage, careful planning can minimise disturbance from external and internal sounds, for example:

- locating the music department to minimise disturbance from noise sources outside and inside the school;
- using sound insensitive spaces such as store rooms or corridors as sound buffers between music-making spaces.[5]

These points are also discussed in Section 1.

Construction

4.19 The main points to remember when designing construction to achieve adequate sound insulation are:

- sound transmission from adjacent spaces is best reduced by mass; any weak elements (eg. poorly sealed doors, key holes, holes for services) will reduce the effectiveness of the sound insulation.
- impact sound will travel with little reduction through a continuous member such as a steel beam or servicing pipe.

4.20 The check list below identifies the main design principles; this is followed by more detailed guidance on the design of doors and windows.

- Walls between sensitive spaces to continue beyond ceiling to structural soffit.
- Construction of doors (including edge detailing and specification of any glazing) to ensure the combined ability of the wall and door to reduce sound transmission is not substantially degraded.[6]
- External windows to be located to reduce sound travelling between adjacent rooms.
- External windows to be designed to control disturbance from outside noise.
- If possible structural members should be discontinuous between sensitive spaces.
- Openings in walls caused by essential services passing through to be acoustically sealed.
- No continuous services pipework/ductwork between music rooms unless absolutely unavoidable. In instances where this is necessary, the pipework must be appropriately boxed-in.[7]

Doors and Windows

4.21 Sound leakage through doors and windows will generally be greater than through the walls. However, significant improvements can be made with appropriate detailing. Suggestions for a practical approach to detailing doors, windows, and observation panels are given below (see also Figures 4/1-4/5).

4.22 In an existing space, it is worthwhile checking doors and windows to establish which elements pose the greatest leakage problems. When all the weak spots have been identified, the worst leaks should be tackled first. Doors and windows should be acoustically sealed when closed – it only takes a small gap to

Notes

[4] See DN17 for recommended background noise levels (an extract is given at Figure 4/6).
[5] A corridor will provide a more effective buffer if there is some treatment such as a carpeted floor or absorbent tiles to the ceiling.
[6] For supervision and safety purposes, doors to teaching spaces normally have a vision panel.
[7] For example, 2 layers of plasterboard carefully sealed with mineral wool/melamine foam in void.

allow sound to leak through. This has been achieved when no light is visible through any part of the door or frame (assuming any glazing is blanked off).

4.23 Using acoustic seals to eliminate gaps is important in reducing airborne sound.

Doors

4.24 The choice of appropriate solid doors and door seals is critical to maintaining effective sound reduction, and controlling the transfer of sound between spaces. Internal doors are often of lightweight hollow core construction, providing only around 15dB of sound insulation - about 30dB worse than a typical masonry wall.[8] In music spaces, heavier solid core type doors[9] should be provided. The insulation value of an existing door can be improved by increasing its mass (eg. by adding two layers of 9mm plywood) as long as the frame and hinges can support the additional weight. It is often simpler to fit a new door.

4.25 The mass of a door is not the only indicator of good sound insulation: the edge detail is also important. Air gaps should be minimised by providing continuous grounds to the frame which are fully sealed to the masonry opening. There should be a generous frame rebate and a proper edge seal all around the door leaf. Ordinary draught excluder is not very effective for acoustically sealing doors; a range of proprietary acoustic sealing strips are available based mainly on neoprene sections. It is important to ensure that the neoprene seal is adequately compressed - but not over compressed - when the door is closed. There are various types of seals for door thresholds including rounded neoprene types sealing against a raised threshold, or spring loaded drop seals. If there is a carpet at the threshold, minimising the gap under the door to 2mm can of itself provide a reasonable threshold seal.

4.26 The graph in Figure 4/1 shows how the performance of a wall decreases with the introduction of a door and how this varies with alternative door solutions. The diagram in Figure 4/2 summarises the desirable features associated with an effective acoustic door installation.

4.27 Where a door has a vision panel, it should be as small as possible. Glazing may be a single sheet of 10-12.5mm glass but in a larger panel a double glazed unit with as large an air gap as possible may be more suitable. The glass should be isolated from the frame by a neoprene gasket. Figure 4/3 shows an installation detail for a door with a vision panel, satisfying the criteria illustrated in Figure 4/2.

Sound Lobbies

4.28 Where noise-sensitive spaces are adjacent to noise-producing spaces,[10] particularly very noisy ones, sound lobbies should be considered ie. a double door arrangement with a lobby in between. The greater the distance between the doors, the better the sound insulation, particularly at low frequencies. Maximum benefit from a lobby is associated with offset door openings as shown in Figure 4/4a. A lobby may be appropriate, for example, between a performance space and a busy entrance hall. Inter-connecting doors between two music spaces should always be avoided.

4.29 Where limitations of space preclude a lobby, a double door in a single wall will be more effective than a single door; this configuration is illustrated in Figure 4/4b.

Windows

4.30 Where a music department is close to a noisy urban area it is important to consider the sound insulation of glazing. Account must also be taken of noise breaking out through windows and potentially disturbing neighbouring residents. Double glazed windows are more

Notes

[8] See also Figure 4/1 for further details.

[9] Such as a 50mm solid core ½ hour fire door.

[10] Details of acoustic standards for insulation between rooms are given in DN17, table 1b.

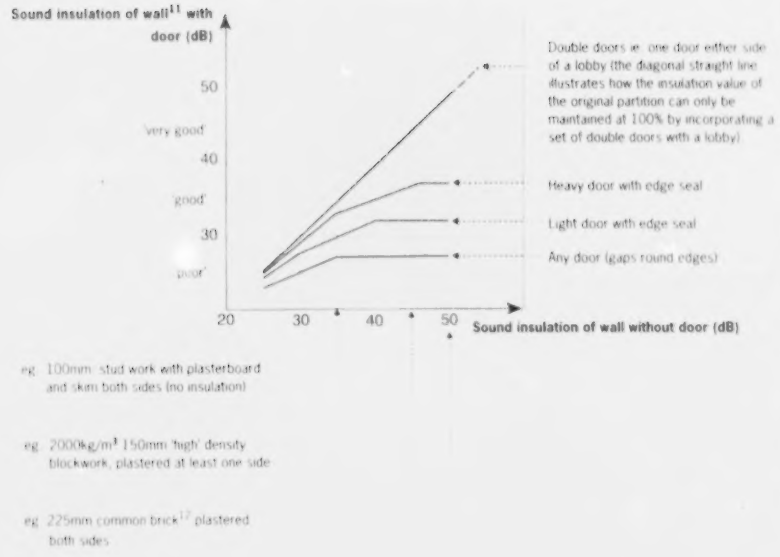
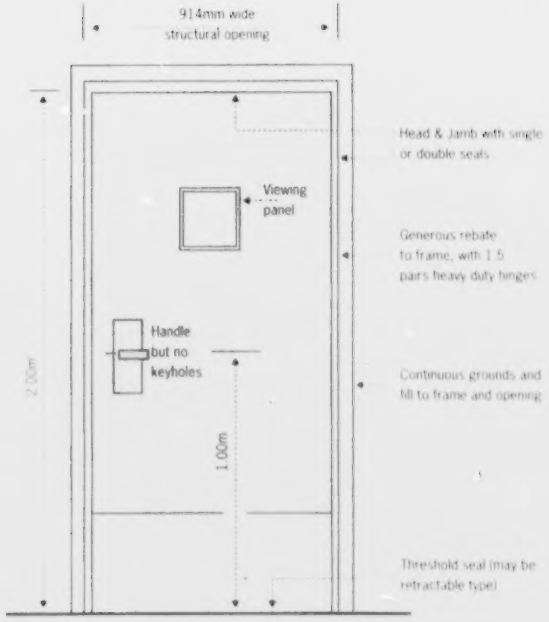

Sound insulation of wall[11] with door (dB)
50
'very good'
40
'good'
30
'poor'
20
30
40
50
Sound insulation of wall without door (dB)
Double doors ie. one door either side of a lobby (the diagonal straight line illustrates how the insulation value of the original partition can only be maintained at 100% by incorporating a set of double doors with a lobby)
Heavy door with edge seal
Light door with edge seal
Any door (gaps round edges)
eg. 100mm stud work with plasterboard and skim both sides (no insulation)
eg. 2000kg/m³ 150mm 'high' density blockwork, plastered at least one side
eg. 225mm common brick[12] plastered both sides

Figure 4/1
Reduction of sound insulation of a wall incorporating different types of door.


914mm wide structural opening
Head & Jamb with single or double seals
Viewing panel
Generous rebate to frame, with 1.5 pairs heavy duty hinges
Handle but no keyholes
2.00m
1.00m
Continuous grounds and fill to frame and opening
Threshold seal (may be retractable type)

Solid core timber door assembly - Elevation - showing how the performance of a door assembly depends on a number of features of the construction, not just on the mass of the door leaf.

Figure 4/2
Desirable features of an effective door installation

Notes
[11] For mean sound insulation values for various partition/door combinations refer to BS 8233: 1987.
[12] Values in examples given are for illustrative purposes only ie. they are not absolute.

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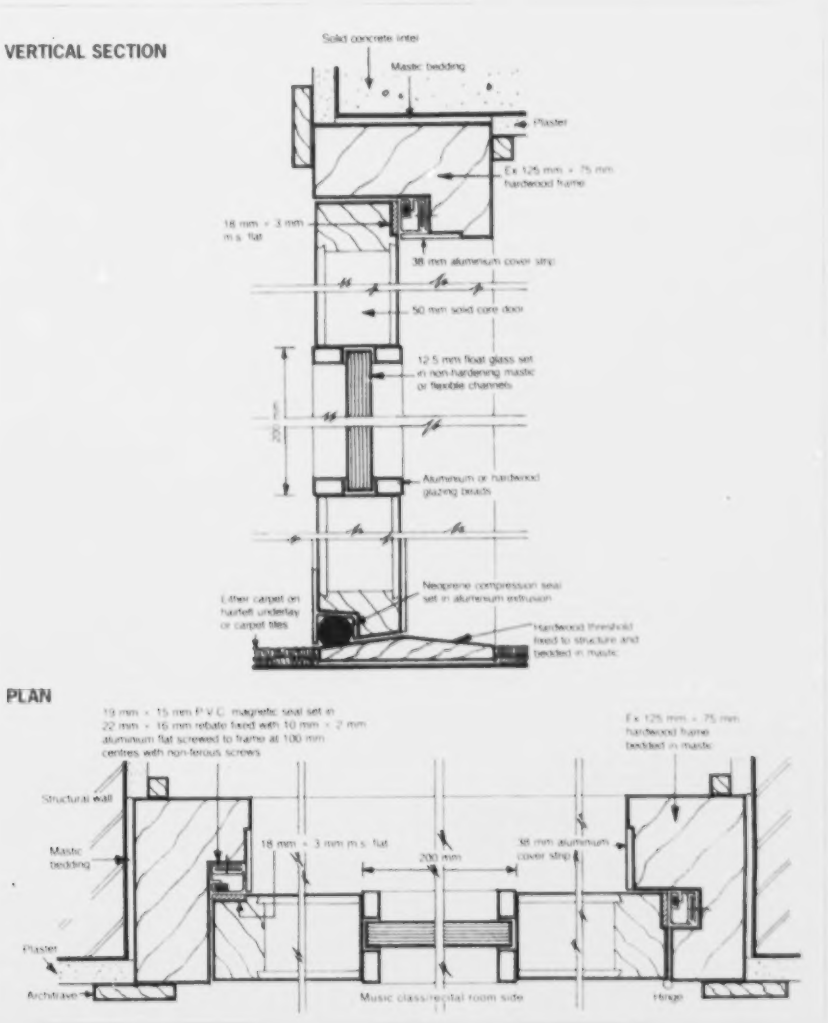
Figure 4/3
Vertical and horizontal sections through a door installation. Taken from BBC Engineering Guide to Acoustic Practice, 2nd Edition 1990. These drawings are reproduced here with the kind permission and co-operation of the BBC.


VERTICAL SECTION
Solid concrete inter
Mastic bedding
Plaster
Ex 125 mm × 75 mm hardwood frame
18 mm × 3 mm m.s. flat
38 mm aluminium cover strip
50 mm solid core door
12·5 mm float glass set in non-hardening mastic or flexible channels
Aluminium or hardwood glazing beads
Neoprene compression seal set in aluminium extrusion
Hardwood threshold fixed to structure and bedded in mastic
Either carpet on hurlett underlay or carpet tiles
PLAN
Structural wall
Mastic bedding
Plaster
Architrave
18 mm × 3 mm m.s. flat
200 mm
38 mm aluminium cover strip
Ex 125 mm × 75 mm hardwood frame bedded in mastic
Music class/recital room side
Hinge

effective at keeping out sound than single glazing of the same thickness. The bigger the gap between panes the greater the acoustic benefit. A gap of 6mm, often used in thermal double glazing, will not be effective. In an existing building, secondary glazing may be installed as an alternative to replacing existing single glazing with double glazing. The effectiveness of secondary glazing will be determined by the thickness of glass and the width of the air gap between the existing window and the secondary glazing. Another alternative may be to fit a completely new double glazed window on the inside of the existing window opening, leaving the original window intact.

Observation Window to Control Room

4.31 Figure 4/5 shows a detail of a typical control room window. Two panes of heavy plate glass (of different thicknesses to avoid the same resonances) are separated by an air gap of about 100-200mm. Such a large gap may not always be possible but 50mm should be considered a minimum. Each pane of glass is mounted into a separate frame to avoid a direct sound path; this is desirable but not essential. The glass is mounted in a neoprene gasket to isolate it from the wooden frame. Acoustically absorbent material, such as mineral wool or acoustic foam, is incorporated into the reveal to absorb any energy that enters the air gap.

40

Summary

4.32 The following summarises the main points of door and window design.

- Doors need to be as heavy as possible, with perimeter and threshold compression seals. Even a small gap can let a lot of sound in or out. There should be no keyholes or other penetrations through the door.
- Double door systems with a lobby significantly outperform single doors.
- Mineral wool insulation, or melamine foam[13] packed into air gaps will help to reduce airborne sound transmission.
- Windows should ideally be double glazed with as large an air gap as possible. Individual panes should be isolated from their frames using a suitable glazing gasket material.

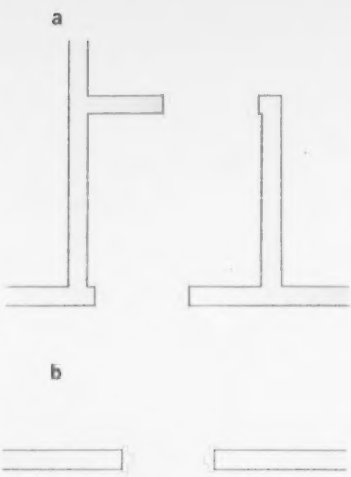


Figure 4/4
a: Lobbied doorway.
b: Double door.

Notes
[13] Melamine foam is often preferred for handling reasons.

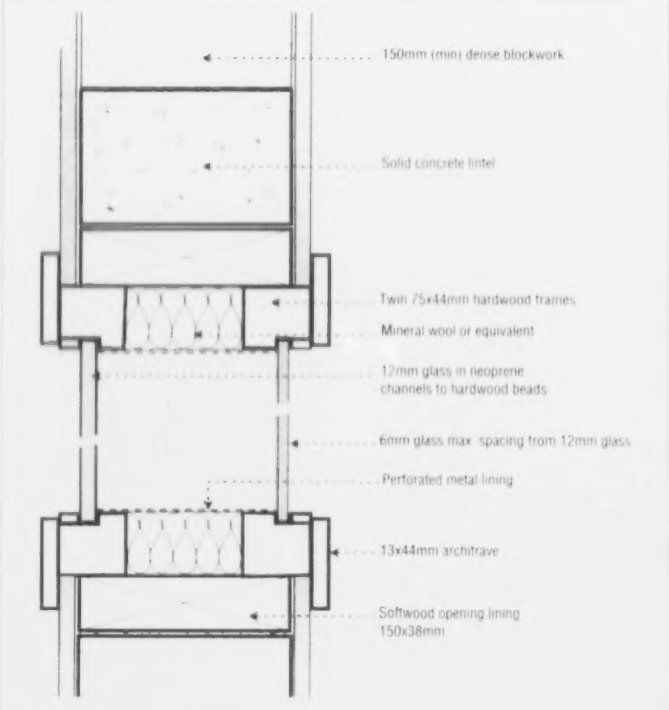
Sound Quality

The behaviour of sound in a room

4.33 The quality of sound in a music room should be an appropriate balance between fullness of tone and clarity. The key factor to achieving this is the reverberation time (RT). In general terms this is the time taken in seconds for a loud sound, when stopped, to decay to inaudibility. A long reverberation time promotes fullness of tone but at the expense of clarity (individual sounds start to overlap each other reducing the clarity). A short RT tends to provide clarity but at the expense of fullness of tone; thus spaces with a very short RT can have a 'dead' quality. In general terms, a shorter RT is recommended for speech, than for music.

4.34 Reverberation time is directly proportional to room volume and inversely proportional to the total acoustic absorption ie. RT increases with room volume and decreases with the amount of absorptive material. Airborne sound energy is absorbed by soft, porous surfaces such as carpets, curtains and people. Conversely, hard, non-porous surfaces such as plastered

Figure 4/5
Section through control room window


150mm (min) dense blockwork
Solid concrete lintel
Twin 75x44mm hardwood frames
Mineral wool or equivalent
12mm glass in neoprene channels to hardwood beads
6mm glass max. spacing from 12mm glass
Perforated metal lining
13x44mm architrave
Softwood opening lining 150x38mm

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brickwork reflect sound energy. Therefore, absorbent surfaces tend to shorten reverberation time whilst reflective surfaces prolong it.

4.35 Room design needs to achieve an appropriate balance between room volume on the one hand, and a combination of absorbent and reflective surfaces on the other. Volume and room finishes are used to optimise reverberation characteristics. In particular, a reverberation time calculation should be made which will take account of the absorption characteristics of surfaces.[14] When necessary, suitably positioned treatment can be applied to ameliorate the effect of acoustically problematic room features such as barrel vaults. A traditional classroom with predominantly hard surface finishes and very limited volume is likely to compromise the acoustic environment required for the necessary range of musical activities.

4.36 Volume is critical to the quality of sound in a music room and a higher than average ceiling is desirable. An increase in volume affects the quality of the sound (the liveliness) and modifies the loudness. Instruments played in a music room that are normally played in a concert hall will sound very loud. It is therefore desirable to have a ceiling height of at least 2.7m in all music rooms, including the group rooms. Additional absorption may be provided to reduce loudness but this will have to be carefully balanced with the need to preserve a quality of liveliness which could be compromised by excessive absorption. It is worth noting that absorptivity within a space is significantly increased by larger numbers of occupants.

Achieving Sound Quality through Design

4.37 Four fundamental characteristics of a successful music space are identified in DN 17 (and quoted here in boxed text). Each of these is discussed in turn.

- *The background noise level should be sufficiently low to permit the full dynamic range of the music to be heard.*

4.38 This implies that the design will achieve low noise levels from neighbouring spaces and also from ventilation, lighting and other building services equipment. Figure 4/6 shows recommended background levels for music spaces.[15]

- *There should be freedom from echoes, flutter echoes, standing waves, focusing and any other acoustic effects which confuse or distort the sound.*[16]

4.39 These acoustic phenomena derive from room geometry. It is important to consider both room shape and proportion. Where the distance between two parallel walls coincides with or is a multiple of a particular wavelength of sound, a standing wave can be set up and the balance of sound is affected. The effect is exaggerated if distances are the same in more than one dimension. Thus rooms which are square in plan[17] should be avoided. Cube-shaped rooms where the same dimensions are repeated in a vertical plane exacerbate this tendency towards sound coloration through standing waves. In short it should not be possible to express any of the room dimensional ratios as whole numbers, eg. a proposed space 7m wide 10.5m long and 3.5m high, 2:3:1, would not be considered an advisable shape from an acoustic point of view. Prominent standing waves can also be avoided by having non-parallel surfaces or increasing surface absorption.

Notes

[14] For recommended values of RT refer to the 1997 revised version of DN 17. An extract is given in Figure 4/7. Refer to BB 51 for absorption characteristics and method of calculation.

[15] For definition of units taken from DN 17 refer to Glossary II: Acoustical terms.

[16] Refer to Glossary for definitions.

[17] This includes symmetrical shapes such as octagons which are derived from squares.

42

4.40 Flutter echoes which occur between parallel walls can be counteracted by the introduction of an angled wall element. For this reason, group rooms illustrated in this document show one wall at approximately 7° off-parallel. In the conversion in Case Study 1, the same effect has been achieved by using angled panels. Flutter echoes in the vertical plane are unlikely if there is a sound absorbing surface such as a carpet or if the ceiling is sloping. Fixtures and furniture including shelving and wall cupboards can also contribute to diffusion of sound. An interrupted run of wall cupboards is more favourable than a continuous run because it affords modelling to the wall surface.

4.41 Certain surfaces can focus sound towards a small area and this is generally undesirable in a school music room; specific focusing geometric forms are best avoided. Particular causal shapes include barrel vaulted or domed ceilings.

- *The reverberation time should be suitable for the activity and should be constant over the mid to high frequency range. An increase of up to 50% is permitted at bass frequencies.*

4.42 The revised version of DN 17 gives recommended reverberation times for a range of different teaching spaces. Figure 4/7 shows an extract giving recommended values applicable in spaces for teaching music.

4.43 In a music classroom, the most suitable reverberation time varies within the recommended 1.0–1.2 seconds range according to the instrument; for example a longer reverberation time, nearer the top of the range, is desirable for choral work. There should therefore be some facility to vary the reverberation of the space to suit a range of likely activities and instruments. Variations can be achieved effectively by the use of heavy curtains/drapes ie. at least 0.5kg/m² at 200% gather.[18] This device has been incorporated in Case Study 1 (Section 5) which has a perimeter ceiling-mounted track installed on three sides of the room. Curtaining in group rooms can also serve to modify reverberation time, attenuate loudness, and discourage standing waves which tend to be more noticeable in small rooms.

Room Type/Activity	Activity Noise Level	Background	
		Tolerance Level	Maximum background noise level from adjacent areas, ventilation and traffic noise $L_{Aeq,1h}$ (dB)
	General Category	General Category	
Music rooms:			
teaching, listening audio	High	Low	30
music practice/group room	High	Low	30
ensemble playing	High	Low	30
recording/control room	High	Low	25
General teaching, seminar and tutorial rooms and classbases	Average	Medium	40
Assembly hall[19]	High	Low	35

Figure 4/6
Recommended acoustic standards: background Noise Level. Taken from DN 17.

- *Sound should be distributed uniformly throughout the room, both in the performance and listening areas. It is beneficial in this respect to model large flat surfaces to a depth of 0.3m or more.*

4.44 In general terms this means that the distribution of reflective and absorptive materials should be evenly balanced throughout the space. Large reflective surfaces ie. walls and ceilings enhance sound distribution if they are broken up by irregularities. In a large space such as a school assembly hall, this may take the form of ribs but in a more modest space, like a music classroom, the same effect may very often be achieved by simple means such as providing perimeter shelving.

Notes

[18] '200% gather' is sometimes referred to as '100% fullness'.
[19] Halls as multifunctional spaces also used for performance of music and drama.
[20] Mid-frequency is the mean of the 500Hz and 1000Hz octave band values.

Room	Approx. size		Recommended unoccupied mid-frequency[20] Reverberation Time (seconds)
	Area (m²)	Height (m)	
Hall (assembly/rehearsal)	250-550	3.7-7.6	1.0-1.4
Music rooms:			
music class/recital	54-91	2.7-3.5	1.0-1.2
ensemble rooms	16-50	2.7-4.0	0.8-1.2
small teaching/practice/ group room	6-10	2.7-3.0	0.4-0.8
recording/control room	8-15	2.4-3.0	0.3-0.8

Figure 4/7
Recommended Reverberation Times. Taken from DN 17.

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4.45 Where concentrations of absorptive materials occur only on the floor and ceiling – for example in a simple solution employing acoustic ceiling tiles and carpeted floor – users may experience an over-emphasis on sound reflections in a horizontal plane. A more balanced solution would be to adopt either carpet or ceiling tiles, and to distribute absorptive material about the vertical wall surfaces of the room.

Application of principles

4.46 Figures 4/8 to 4/11 show how the principles described have been applied to the sample plans illustrated in Section 2. These are not complete design solutions because they are hypothetical examples. In reality each case needs to be considered in relation to its context.

The Music Classroom

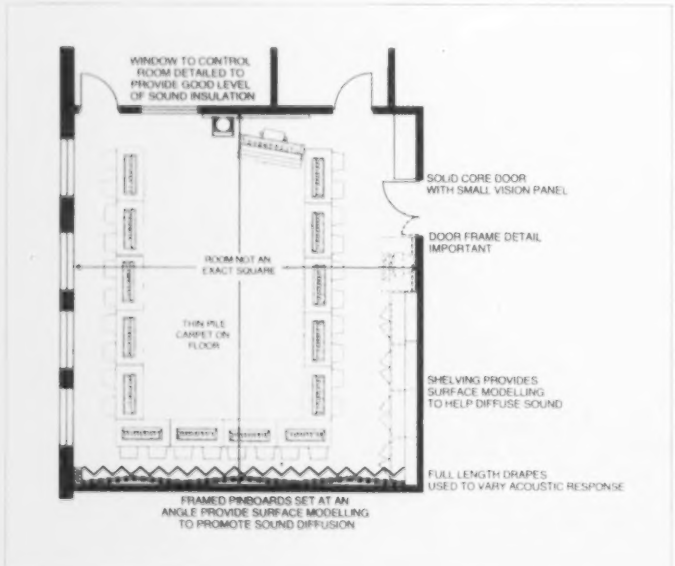
4.47 Figure 4/8 shows one of the 65m² music classrooms where a range of class-based activities will take place, involving a number of different instruments. The room proportion avoids an exact square. The height is assumed to be between 2.7m and 3m, creating a reasonable volume for the activities (see paragraph 4.39 for a discussion on room proportion). The main points to note about the acoustic treatment of the space are listed below.

- In order to minimise the possibility of flutter echoes or standing waves occurring between opposing parallel walls, surfaces are modelled to promote sound diffusion. On the side wall this takes the form of shelving, assumed to be storing percussion instruments etc. On the back wall, framed pinboards (with non-absorptive covering) are set at an angle, breaking up an otherwise plain surface.
- Full length heavy drapes along the back wall can be drawn across to vary the acoustic response of the space.
- The observation window into the adjacent control room is detailed to ensure a high level of sound insulation between the two spaces (see Figure 4/5).
- The door into the room is of solid core construction with a small vision panel (see Figure 4/3). The door and frame detail is designed to maximise the sound insulation properties of the wall as a whole.
- In order to avoid an over-emphasis of sound in one plane, the floor is fitted with a thin pile carpet providing an absorbent surface while the ceiling has a hard reflective surface.[21]

Notes

[21] The type of carpet can have a significant effect on the overall RT in a room. It is worthwhile checking the absorption coefficent of any chosen surface finish (refer to Building Bulletin 51).

Figure 4/8
Acoustic treatment to music classroom


WINDOW TO CONTROL ROOM DETAILED TO PROVIDE GOOD LEVEL OF SOUND INSULATION
SOLID CORE DOOR WITH SMALL VISION PANEL
DOOR FRAME DETAIL IMPORTANT
ROOM NOT AN EXACT SQUARE
THIN PILE CARPET ON FLOOR
SHELVING PROVIDES SURFACE MODELLING TO HELP DIFFUSE SOUND
FULL LENGTH DRAPES USED TO VARY ACOUSTIC RESPONSE
FRAMED PINBOARDS SET AT AN ANGLE PROVIDE SURFACE MODELLING TO PROMOTE SOUND DIFFUSION

The Music Classroom/Recital Room

4.48 Figure 4/9 shows one of the larger classrooms (85m²) illustrated in Section 2. The proportions of the room are in a ratio of fractional numbers (2.6:3.8:1) with the height in the same range as Figure 4/8. The acoustic treatment is similar to that for the 65m² room but as this space is larger, and bigger groups are likely to rehearse and perform here, drapes are provided on two adjacent walls.

The Group Room

4.49 Figure 4/10 shows a typical 8m² group room which will accommodate both instrumental lessons and composition groups. A range of instruments will be played, and groups may be up to 6 in number. As the sound created could be very loud in this small space, the ceiling is at least 2.7m (see paragraph 4.36). Points to note are as follows.

- One wall is at an angle of 7° to discourage flutter echoes (a particular issue in small rooms) and prominent standing waves. Window and door reveals and coat hooks provide useful modelling to other walls.
- A full length drape can be pulled across the window to increase surface absorption and reduce loudness (eg. when 5 or 6 percussionists are playing).
- The window is fairly small and positioned in the centre of the wall to control the amount of external noise reaching the space and avoid sound travelling between adjacent group rooms.
- Floor and ceiling finishes are as the larger rooms.

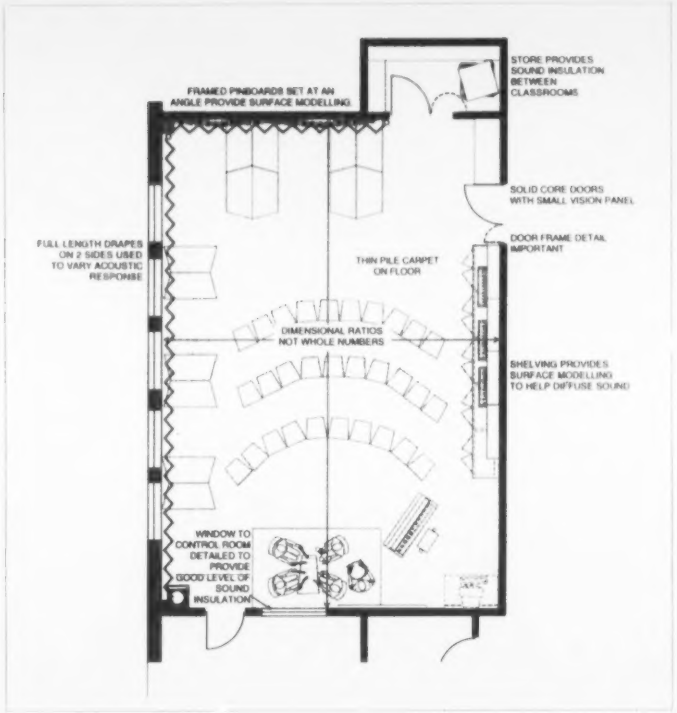

STORE PROVIDES SOUND INSULATION BETWEEN CLASSROOMS
FRAMED PINBOARDS SET AT AN ANGLE PROVIDE SURFACE MODELLING
SOLID CORE DOORS WITH SMALL VISION PANEL
DOOR FRAME DETAIL IMPORTANT
FULL LENGTH DRAPES ON 2 SIDES USED TO VARY ACOUSTIC RESPONSE
THIN PILE CARPET ON FLOOR
DIMENSIONAL RATIOS NOT WHOLE NUMBERS
SHELVING PROVIDES SURFACE MODELLING TO HELP DIFFUSE SOUND
WINDOW TO CONTROL ROOM DETAILED TO PROVIDE GOOD LEVEL OF SOUND INSULATION

Figure 4/9
Acoustic treatment to music class/recital room

Figure 4/10
Acoustic treatment to 8m² group room

The Recording/Control Room

4.50 Figure 4/11 shows the 11m² recording/control room described in Section 2. A teacher or pupil will record a music performance taking place in an adjacent space after which the recording may be heard on headphones or loudspeakers. The recommended range of RT is 0.3 to 0.8 seconds with the lower figure more applicable to the control room function. Notable aspects of the acoustic treatment are given here.

- Sound absorbing panels on the walls behind the speakers are used to control strong early sound reflections which could distort loudspeaker sound.
- Shelving units on the window wall provide surface modelling.
- Drapes are fitted on all three observation windows. If a curtain is pulled across one

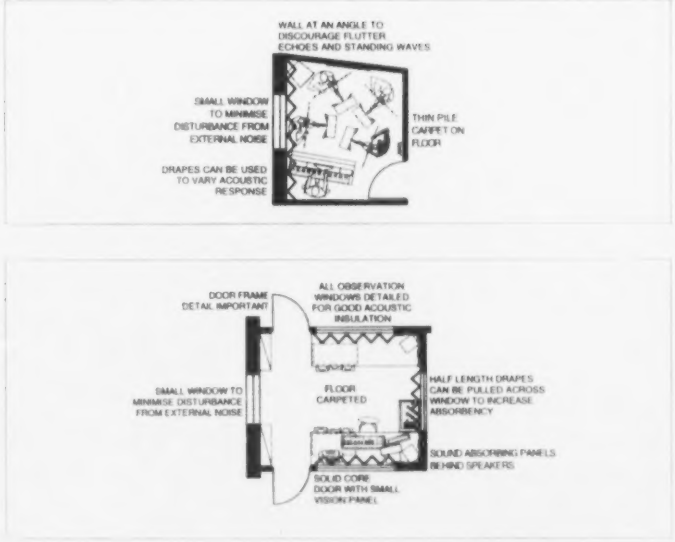

WALL AT AN ANGLE TO DISCOURAGE FLUTTER ECHOES AND STANDING WAVES
SMALL WINDOW TO MINIMISE DISTURBANCE FROM EXTERNAL NOISE
THIN PILE CARPET ON FLOOR
DRAPES CAN BE USED TO VARY ACOUSTIC RESPONSE
DOOR FRAME DETAIL IMPORTANT
ALL OBSERVATION WINDOWS DETAILED FOR GOOD ACOUSTIC INSULATION
SMALL WINDOW TO MINIMISE DISTURBANCE FROM EXTERNAL NOISE
FLOOR CARPETED
HALF LENGTH DRAPES CAN BE PULLED ACROSS WINDOW TO INCREASE ABSORBENCY
SOUND ABSORBING PANELS BEHIND SPEAKERS
SOLID CORE DOOR WITH SMALL VISION PANEL

Figure 4/11
Acoustic treatment to recording/control room

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window, problems of flutter echoes and prominent resonances associated with two facing hard parallel surfaces will be reduced.[22] Drapes also provide additional privacy.

- The external window is small to minimise disturbance from external noise. A venetian blind can be used to control sunlight.
- The floor is carpeted.

Heating and ventilation

4.51 The School Premises Regulations state that each teaching space should be provided with '*...controllable ventilation at a minimum rate of 3 litres of fresh air per second for each of the maximum number of persons the area will accommodate*', with the capability of increasing to a '*...minimum rate of 8 litres of fresh air per second for each of the usual number of people in those areas...*'. In a music room this requirement has to be considered in the context of achieving good acoustic insulation and windows and rooflights will need to be carefully detailed.

4.52 There may be spaces such as internal group rooms where mechanical ventilation is required. The need for a satisfactory level of ventilation will have to be balanced with the need for a suitable acoustic environment (see Figure 4/6 for recommended background noise levels). A system must be designed so that any noise produced is not of a kind to cause disturbance. For example when specifying a fan, careful consideration should be given to the inherent mechanical noise level. In small rooms it is possible that an appropriate level of background ventilation can be achieved by the use of a passive solution such as an acoustic air brick. In any teaching space the heating or ventilation system should not produce distracting noise. However, low background noise of services can sometimes be used to mask other, more intrusive noises.

4.53 Musical instruments generally benefit from a fairly constant level of warmth and humidity. The drying effect of heating on some traditional instruments in particular should be considered, and it is advisable to avoid overheating storerooms. In such spaces, minimal heating – say to a winter temperature of 10°C – is adequate to ensure that no condensation occurs.

Lighting

4.54 The School Premises Regulations state that any work surface in a teaching space should receive a minimum of 300 lux of illumination. Design Note 17 advises that, as far as possible, every teaching space should be naturally lit. In music rooms a balance will need to be achieved between the desirability for natural light and the need to minimise noise disturbance from outside. Double glazed openable units may be the most cost effective solution.

4.55 Group rooms are small and often internal but wherever possible daylight from windows is preferable. Rooflights[23] are an alternative but in small rooms a view of the outside can relieve the possible sense of claustrophobia. The sound of rain on rooflights or metal roofs can also be distracting when playing or listening to instruments, or singing.

4.56 Most classrooms benefit from blinds or curtains to the windows. These may be used to provide a sense of privacy during musical performances or to dim the light when an OHP or video is being used. Blinds can also be used to control sunlight and in order to reduce reflections on a whiteboard or computer screen. Heavy curtains may also provide an economical form of acoustic control (see paragraph 4.43.)

4.57 The requirements for electric lighting are no different from any general teaching space. In a music classroom some additional directional lighting, possibly with some dimming facility, can be a bonus for highlighting performers and drawing attention to display areas. A space which is used frequently for formal performances, such as the school hall, may require specialist theatre lights.

4.58 It is worth noting that some people, particularly those sensitive to music, can be bothered by the mains hum from fluorescent light fittings. This does not occur with high frequency fittings which are sometimes specified for this reason. In certain spaces such as the recording/control room, the sound caused by transformers used with low voltage spotlights can be distracting.

Notes

[22] Ideally the effect can be precluded by installing glazing in one of each pair of windows at 5° off parallel.

[23] Rooflights can be a security risk. The composite design must be carefully considered to prevent access by intruders.

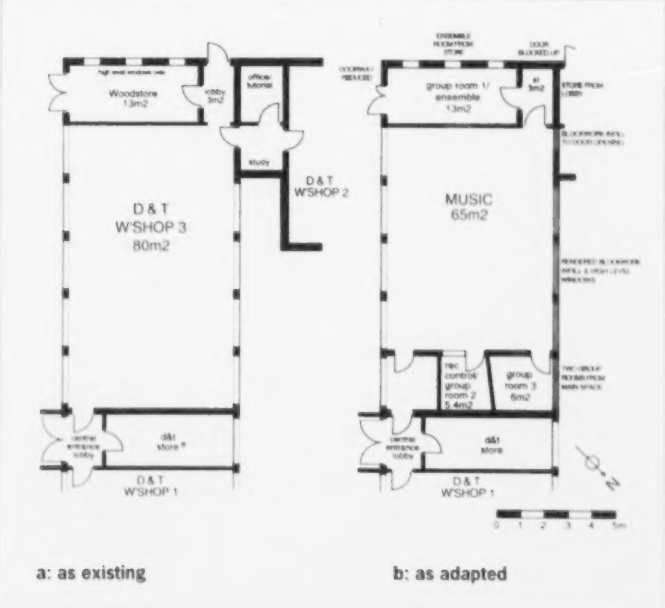
Section 5: Case Studies

This section shows the guidance given in Sections 1 to 4 applied to existing schools. There are three case studies; two are design studies for adaptations to existing schools and one is a new building. The number of pupils on roll varies from 600 to 1850 in total and two of the schools have sixth forms. There is a cost analysis of Case Study 1 in Section 6.

5.1 Existing school buildings may have spaces that are less than ideal and compromises have to be made. The two adaptations (Case Studies 1 & 3) raise typical issues about making choices; in both cases priority is given to teaching area. As these are design studies each space is shown totally re-furnished and re-equipped, based on the strategy outlined in Section 2. In reality, schools may wish to re-use some of their existing furniture. The furniture for the new building project (Case Study 2) is shown as it was installed.

5.2 Case Study 1 is an example of the practical guidance given in Section 4. It describes the changes made to the construction and finishes to enhance and improve the acoustic environment.

Figure 5/1
Case Study 1



a: as existing

b: as adapted

Case Study 1: Adapting a Design and Technology Space

As Existing (Figure 5/1a)

5.3 Case Study 1 is an 11-16 comprehensive school with 600 pupils on roll. At KS3, 5% of curricular time is spent on music. The music department is considering expanding its GCSE group and accommodating extended curricular work.

5.4 The curriculum is constrained by the limitations of the existing accommodation, a 45m² classroom. There are no associated smaller spaces for composing or instrumental teaching. The release of an existing workshop has resulted from the reorganisation of the design and technology suite. An overall floor area of 96m² is available which includes an adjacent 13m² woodstore with independent access.

5.5 Originally the workshop was built in 1954 using a prefabricated, reinforced concrete system of modular design having concrete roof panels and double skin walls; there is a wood block floor. The south-east and north-west facades of the building are fully glazed from a sill height of about 1.0m. The existing ceiling height in the main space is 3.3m. The size of the space is suitable for a music room but there are some disadvantages with the accommodation.

- Existing floor and ceiling surfaces are hard, resulting in an unacceptably long reverberation time of 2 seconds. Standing waves and flutter echoes are likely due to parallel walls and hard surfaces.
- The north-west wall abuts the school playing field. The extent of glazing is excessive and considered undesirable from a security point of view on a side with potential for intrusion.
- The school playground, a potential source of noise, is adjacent to the south-east wall.

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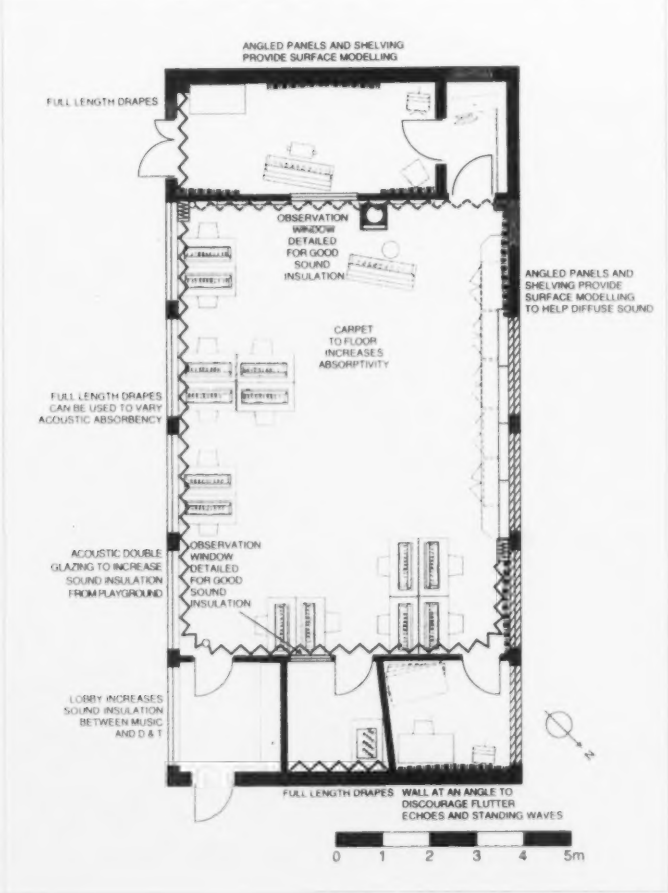
- A design and technology workshop is adjacent (although an entrance lobby and store provide a buffer between the teaching spaces).
- The building is free-standing and circulation is external which results in an excessive number of entrances.

The Adaptation (Figure 5/1b)

5.6 Minimal structural alterations are proposed in order to constrain costs and maximise available funds for acoustic treatments and finishes. Within the existing area, it is possible to provide a music room of 65m², three group rooms and a store. It is assumed that performances to an audience or large scale rehearsals take place in the school hall. The largest group room (or ensemble room) is converted from the existing store and can be accessed separately, if necessary, to avoid disturbing classes. The dimensions of this space are not ideal as proportions are long and narrow but compromise has been accepted and the wall treatment is designed to optimise room responses. An entrance lobby houses coats and bags and provides additional sound insulation between the main space and the adjacent D&T room.

5.7 The main features of the adaptation are described below. The sound insulation of the music classroom is considered a priority. The key aspects of the acoustic treatment and the furnished floor plan are shown separately for clarity (Figures 5/2 and 5/3).

Figure 5/2
Case Study 1: acoustic treatment


ANGLED PANELS AND SHELVING PROVIDE SURFACE MODELLING
FULL LENGTH DRAPES
OBSERVATION WINDOW DETAILED FOR GOOD SOUND INSULATION
ANGLED PANELS AND SHELVING PROVIDE SURFACE MODELLING TO HELP DIFFUSE SOUND
CARPET TO FLOOR INCREASES ABSORPTIVITY
FULL LENGTH DRAPES CAN BE USED TO VARY ACOUSTIC ABSORBENCY
ACOUSTIC DOUBLE GLAZING TO INCREASE SOUND INSULATION FROM PLAYGROUND
OBSERVATION WINDOW DETAILED FOR GOOD SOUND INSULATION
LOBBY INCREASES SOUND INSULATION BETWEEN MUSIC AND D & T
FULL LENGTH DRAPES
WALL AT AN ANGLE TO DISCOURAGE FLUTTER ECHOES AND STANDING WAVES
0 1 2 3 4 5m

Construction (Figure 5/2)

- In order to improve security, glazing to the north-west wall is removed and the opening is infilled up to two thirds of its height with rendered blockwork. Medium density block (1500kg/m³) is used to give appropriate sound insulation. The top third of each panel is thermally and acoustically double glazed with bottom-hung openable fanlights.
- Angled panels of medium density particle board are fixed to studding on the inside face of the north-west wall of the main space. These help to prevent standing waves between parallel side walls and can provide much needed display space. The panels are without fabric covering since this would compromise the high frequency response. Panels are omitted where there are shelves as these have an equivalent acoustic effect. Angled panels are also used in the group rooms.
- Secondary 'acoustic' glazing is added to the windows to the south-east (playground) side, as two sliding panels. This allows access for maintenance and to open casements or fanlights. Solar reflective film is added to the outside of the existing fenestration to reduce solar gain. In a new building, an alternative solution may be to incorporate a fixed sunshade or 'brise soleil' at the eaves soffit.

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- Internal doors into the music classroom, the adjacent D&T space and the ensemble room are upgraded to heavy solid core doors with double seals all round including threshold seals. Doors to the two group rooms have vision panels for supervision with 10mm glass (see paragraph 4.27, Section 4).
- Acoustically double glazed observation windows are formed in the partition walls to the ensemble room and one of the group rooms.[1]

Fixtures and Finishes (Figure 5/2)

- The existing plasterboard ceiling finish is retained; the existing wood block floor to the main space is also retained and carpeted for acoustic reasons. The ensemble room floor has a basic underlay and corded carpet, so that the finish is not too acoustically absorptive.
- Wall finishes in the main space are supplemented by heavy drapes of at least 0.5kg/m² at 200% gather, providing acoustic variability and control. The curtain track is ceiling mounted along three sides of the room providing maximum flexibility allowing curtains to be positioned to suit the configuration of the musical activity.[2]
- Curtains are also provided in group rooms. In the ensemble room, they are positioned at the south-east end of the space, screening the doorway or bunched in the corner as required.

The Furniture Layout (Figure 5/3)

5.8 The classroom layout follows the principles described in Section 2 with a teaching focus at one end of the space, sufficient work surfaces for up to 30 pupils and a free area for performances and whole group gatherings. Particular points to note are given below.

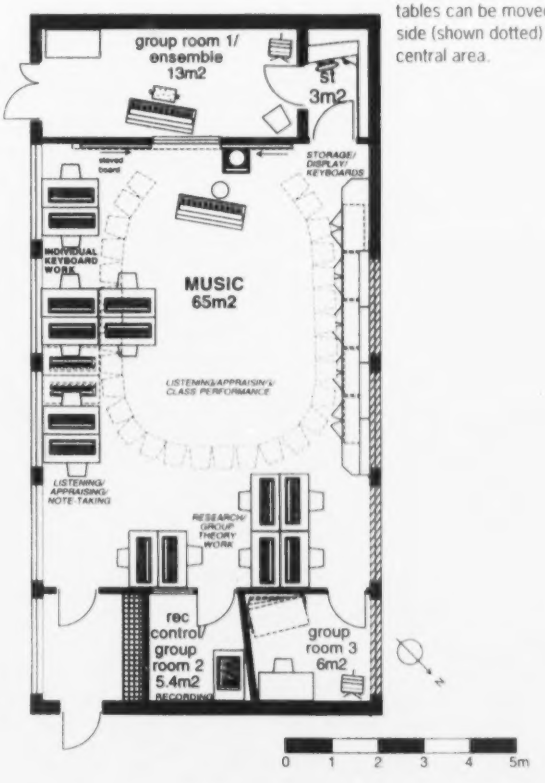
- The two whiteboards, one plain, one staved, are on a track and can be moved to cover the observation window to the ensemble room.
- Power sockets are provided around the perimeter. Keyboard work cannot easily take place in the centre of the space.
- The space can be completely cleared, for recitals or rehearsals, by storing the tables in one of the group rooms.
- The storage wall consists of underbench cupboards on castors and open shelving above.
- The store room which doubles as a teacher's base has a continuous sitting height bench with shelves above providing a work surface and place for storing pupils' records, text books etc.
- Recording equipment (shown in group room 2) is housed on a trolley allowing it be used in more than one space.

Notes

[1] The method of ventilation in group room 2, whether by natural or mechanical means, would need careful calculation to achieve a balance of adequate ventilation and reasonable background noise level (*ref: Section 4, 'Ventilation'*).

[2] This is useful in a school where one classroom serves a number of functions.

Figure 5/3
Case Study 1: the furniture layout



Note:
tables can be moved to one side (shown dotted) to clear central area.

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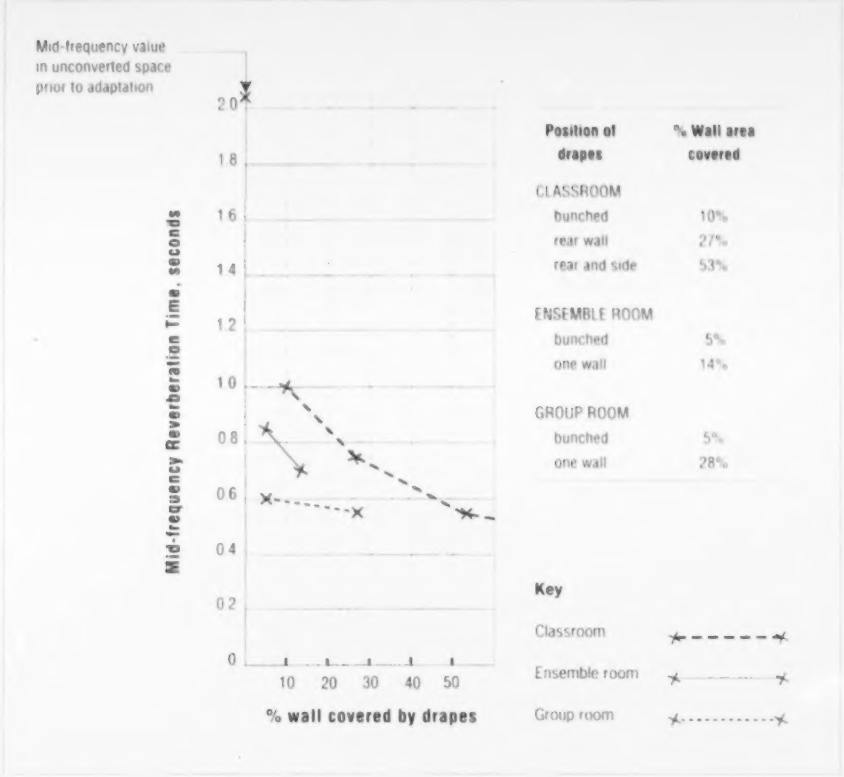


Figure 5/4
Graph showing effect of drapes on reverberation time in classroom, ensemble room and group room.

Resulting Room Acoustic

5.9 This design study formed the basis of an adaptation project at the school. On completion, acoustic measurements were taken in the music classroom, ensemble room and a group room (all when unoccupied). Resulting mid-frequency[3] reverberation times are depicted in Figure 5/4. This graph shows that measured values are in accordance with recommendations in DN 17 (see Figure 4/7) and demonstrates the potential of acoustic variability using drapes. The values are in contrast with the measured reverberation time in the unadapted space which was in excess of two seconds. In the 65m² classroom it can be seen that using curtains effectively changes the nature of the room acoustic from that of a general teaching space to a music class/recital room. Because of the number of variables combining to affect the reverberation time in a room including volume, the weight and location of curtains, surface finishes and furniture, the results shown here are indicative only. In this example the ensemble room at 13m² approximates to a large group room. The graph shows that the room response conforms with the recommended RT of between 0.4 and 0.8 seconds when curtains are extended. The measured RT with curtains bunched shows the room response approximating to that of a small ensemble space.

5.10 The background noise level in the unoccupied classroom measured whilst adjacent classes were in session was 29 $dBL_{Aeq,1hr}$. This accords with the maximum recommended background noise level criterion of 30 $dBL_{Aeq,1hr}$ given in DN 17. Figure 4/6 shows corresponding figures extracted from DN 17.

Notes
[3] Values are mid frequency mean of 500Hz and 1000Hz octave bands measured in unoccupied rooms.

Case study 2: A Purpose-built Suite

Background

5.11 Case Study 2 is an 11-18 school with 650 pupils on roll. The music department was inadequate for the current curriculum and has been replaced by a new self-contained suite. There will be a technical appraisal in a forthcoming DfEE Building Bulletin on acoustics in school buildings (see Bibliography).

The New Building (Figure 5/5)

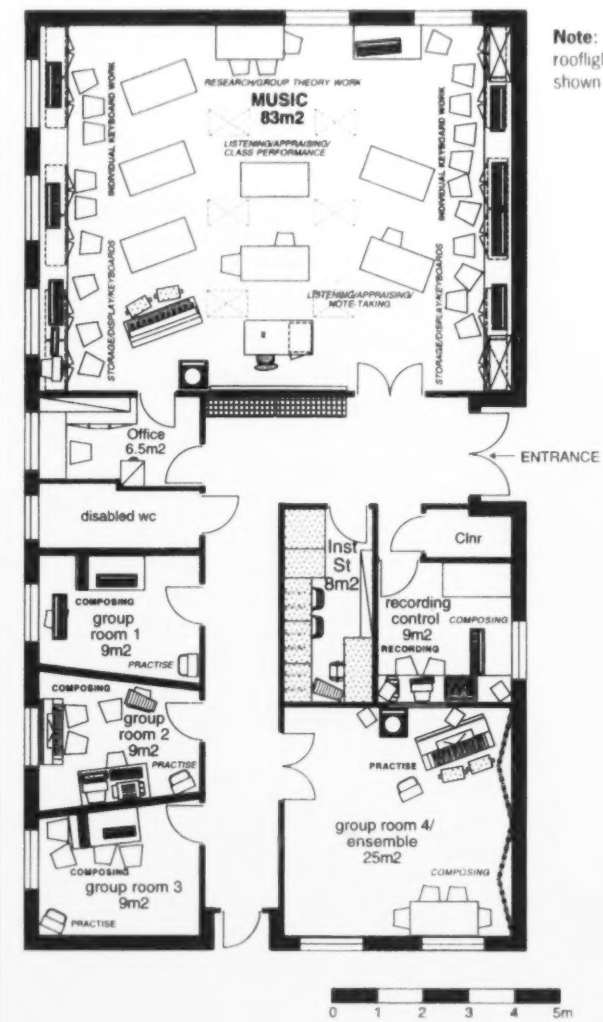
5.12 The timetable requirements were for one main teaching space and one small room for extra curricular instrumental lessons. These are supported by three group rooms[4] and a recording/control room, all lit by daylight from side windows. The main features of the plan are listed below.

- The main space is large enough (83m²) for small performances and extended curricular rehearsals for choirs, bands, ensembles etc.
- The ensemble room is large enough for groups of up to about 12 pupils depending on their instruments (see Figure 2/8). A drum kit could be kept in this room.
- All other group rooms are 9m², allowing for flexibility of use, and incorporate at least one non-parallel wall.
- The recording/control room has visual and audio links with the ensemble room and audio links with the main music space.
- There is one store for general resources, which doubles as an office, and another for instruments. Coats and bags are kept in racks in the corridor outside the classroom.
- The corridor acts as an acoustic barrier between the ensemble room and other teaching spaces. Non-teaching spaces are also used as acoustic buffer zones: for example, between the classroom and group room and between the control room and group rooms.
- Fixed side benches on two sides of the main space are used for keyboard work. Socket outlets on other walls also allow keyboards to be used on tables. Instruments can be stored in under-bench cupboards when not in use.
- The nine tables in the classroom are larger (1800 x 900mm) than average, providing enough work surface for up to 36 pupils. Tables are used in the group rooms for keyboard work.
- Pianos are kept permanently in the classroom, ensemble room and one group room.

Notes

[4] Although the ensemble room is used primarily for instrumental lessons, there is flexibility of use between this and the three smaller group rooms.

Figure 5/5
Case Study 2: the furnished plan



Note: rooflights shown dotted.

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Case Study 3: Extending a Large Department

As Existing (Figure 5/6a)

5.13 Case Study 3 is a large mixed comprehensive school with 1500 pupils in years 7 to 11 and 150 additional pupils in the VIth form. Numbers are rising towards a maximum of 1650 in KS3 and KS4, and about 200 are expected in the VIth form. The school's recently acquired community status provides additional support to extended curricular activities, particularly those relating to the arts.

5.14 The school has a thriving musical population, with 20% of pupils taking music in KS4. The number of specialist teachers is approaching 4 FTE (see Glossary 1), and there are currently 1.6 FTE peripatetic teachers supporting 300 (20%) instrumentalists.

5.15 Existing accommodation for music (Figure 5/6a), which was purpose built in the early 1970s as part of a performing arts block, comprises two large music classrooms (88m² and 103m²), an ensemble space at 17m² and two group rooms at 10 and 11m²; there is also a small office and a recording/control room. There are no store rooms; storage is in the classroom. A dedicated drama studio (108m²) situated in the same block is to be relocated as part of a reorganisation and redevelopment strategy by the school. Music lessons also take place in a mobile classroom.

The Adaptation (Figure 5/6b)

5.16 Figure 5/6b shows the main changes to the existing building including extension (shown tinted) and adaptation. The proposal is based on a schedule of accommodation derived from predicted pupil numbers and curricular organisation (see Figure 5/7, the existing profile is shown alongside for comparison).

Figure 5/6
Case Study 3 as existing and as adapted

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CASE STUDY 3 PROFILE	Proposed		Existing	
		space m²		space m²
School size (11-16)	1650		1500	
VIth form size	200		150	
Timetable periods per fortnight	50		50	
[5] Teaching periods KS3 (music)	99		90	
[6] Teaching periods KS4	30		30	
[7, 8] Teaching periods VIth Form	30		20	
FTE class music teachers	3.98		3.50	
Music classroom spaces (calculated)	3.18		2.80	
No. classroom spaces (rounded)	**4**	**85**	3	88 dedicated
		65		103 dedicated
		65		54 hutted
		65		
[9] Frequency of use	80%		93%	
Average group size: KS3	30		30	
Group/Practice rooms	**12**		2	10
	(say 12 x 7m²)	**84**		11
Instrumental lessons at 20% of roll	370		330	
[10] Sessions	185		83	
Total peripatetic taught time in hours	92.5		55	
[11] No. peripatetic spaces (calculated)	2.64		1.57	
[12] **No. peripatetic teaching spaces (rounded)**	**3**		2	17
	(say 1 x 25m² & 2 x 8m²)	**41**		(11) group room
R/Control room	1	10	1	9
Tutorial/Office	2	14	1	6
Classroom storage (at 5m²/class)	4	20		3
Instrument storage		15		
Total teaching area		**415**		292
Teaching area/workplace		3.45		3.24

Figure 5/7
Case Study 3 Accommodation: existing and proposed

Notes
[5] ie. 3 periods/group/fortnight (6%)
[6] ie. 5 periods/group/fortnight (10%)
[7] ie.10 periods/group/fortnight (20%). There are 2 parallel groups.
[8] The proposed model incorporates a new A-level music technology course also at 20% timetabled time; some aspects of the curriculum can be undertaken by both groups simultaneously sharing one space, therefore number of periods is shown at 30 not 40.
[9] See Glossary I.
[10] Proposed sessions 30 minutes, average group size 2. Existing 40 minutes, average group size 4.
[11] An FTE peripatetic teaching week comprises 35 hours.
[12] This indicates 3 peripatetic spaces, but there is scope for some use of class/group rooms. This is indicated by scheduled frequency of use at 80% and the expectation that A-level groups will not need a whole classroom for every session.

5.17 From the schedule, it can be seen that:

- the total number of music teaching periods for the proposed increase in numbers is 159, suggesting four music classrooms at 80% use;
- a total of 12 group rooms is considered sufficient taking into account sixth form use of the spaces;
- the high 'take-up' of instrumental lessons suggests the need for three spaces (preferably located in the building).

5.18 The solution closely matches the schedule in Figure 5/7 with some allowance for flexible use of support spaces whether for teaching or non-teaching activity. The drama space becomes the third music space and the new extension the fourth. Internal adaptations provide improved support spaces and storage is increased. This scheme is for a particularly large school with a high level of musical activity but many of the issues addressed apply to smaller schools. The main building changes are listed here.

- The access to the suite is relocated to provide a more direct approach to the centre of the block.
- The toilets are removed to provide additional support space. This need is given priority over the advantage of having toilets in the block for evening use.

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- Some group rooms open directly from a classroom and others are accessed from circulation space. The former may be appropriate for pupils requiring closer supervision, but care must be taken in detailing the doors to ensure acoustic separation.
- One of the two original classrooms is retained at 88m² to be used as a recital/rehearsal space; this space is nearest to the main entrance for ease of access by the community. The second music classroom and drama room are reduced in size to around 65m² leaving sufficient area to provide additional group rooms.
- The 25m² ensemble space is intended as the main instrumental base. It has an access via a small office which acts as a central reference point for peripatetic teachers and their pupils. This can be reached independently from the outside, providing a separate approach for instrumental teachers and scope for small performances. Extended curricular instrumental lessons can also take place in one of the group rooms opening off the circulation space.
- All new group rooms have non-parallel walls to avoid multiple sound reflections which can cause flutter echoes and prominent standing waves.
- The recording/control room has visual links with two classrooms and a group room.
- There are two tutorial offices of 6m² which can double as group rooms.
- Wherever possible, storage areas are used to provide acoustic buffer zones.

The Furniture Layout (Figure 5/8)

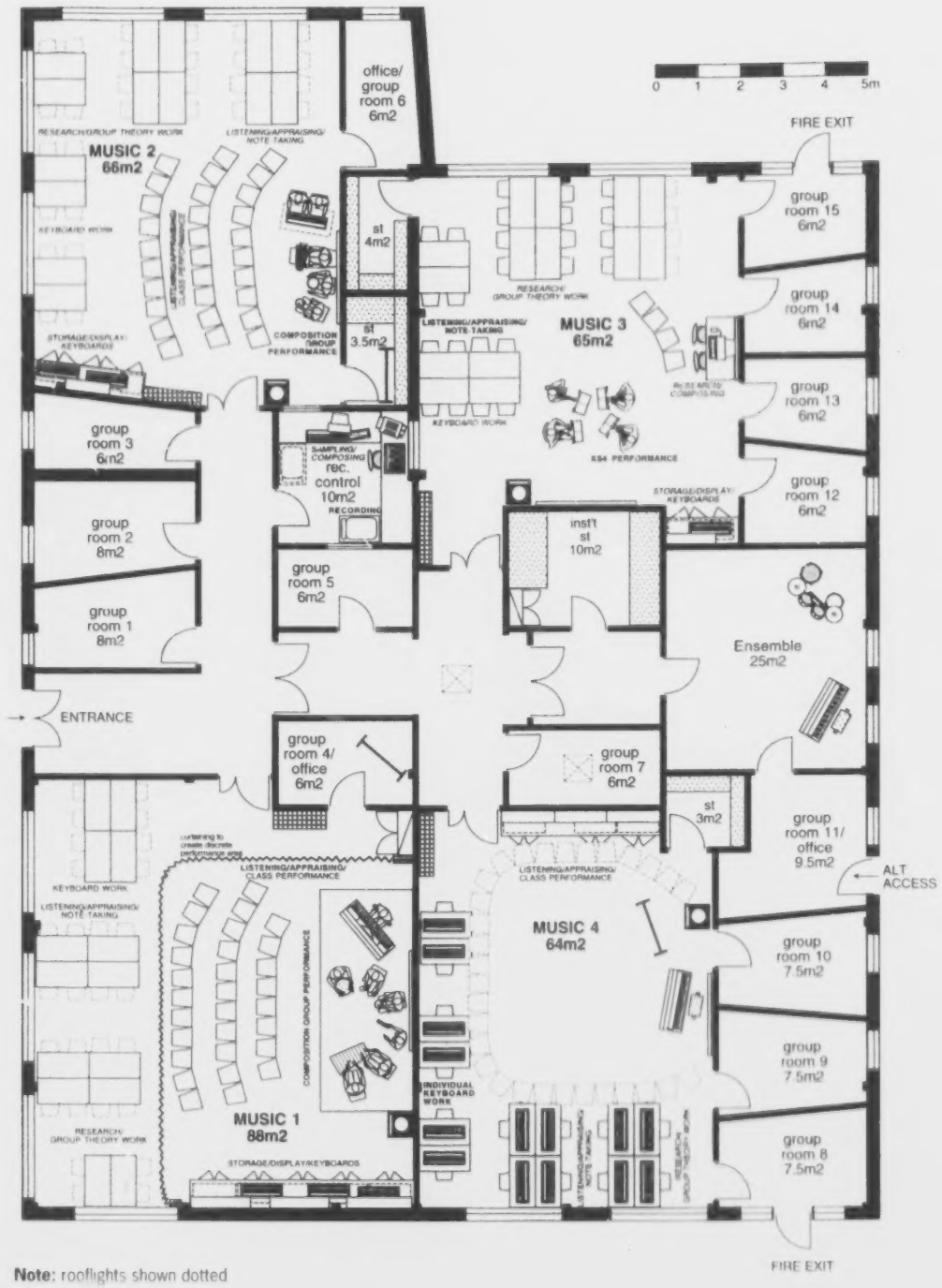
5.19 The rooms are arranged according to the principles in Section 2. One of the main differences is the restriction imposed by the additional doors where group rooms open directly off the music classroom. A particular activity is shown taking place in each of the four music rooms but every space is flexible enough to accommodate a range of activities. The key features of the four classroom layouts are outlined below.

Music 1. This is the largest room and is seen as the class/recital room. The layout shows a group performing to the class. A stage is set up and the performance area is defined by a curtain. Unlike the layout in Section 2, the tables are concentrated along one side of the room. A mobile whiteboard, kept in the store during the performance, can be positioned to suit the activity taking place or moved to another space if required. The staging can be kept in the store room in place of the whiteboard when not in use.

Music 2. The layout indicates a KS3 class appraising a small group performance. The performance can be seen and recorded from the adjacent recording/control space.

Music 3. The room is shown set up for a KS4 performance with pupils sitting at tables to take notes. The number of doors opening off the space, compared to the plans shown in Section 2, limits the length of available wall space and constrains the furniture arrangement. The length of side benching is minimal.

Music 4. Chairs are arranged in a horseshoe for whole class singing, or composition. Tables are arranged for individual keyboard work (assuming part of the class are using group rooms). The number of doors causes some limitation, as in Music 3. A mobile white board, used here to facilitate sight lines, is shown.



Note: rooflights shown dotted

Figure 5/8
Case Study 3 : furnished layout

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Section 6: Cost Guidance

This section provides general guidance on the cost of building music accommodation in secondary schools. It also includes a cost analysis of Case Study 1 in Section 5.

General Cost Matters

Building Consultants' Fees

6.1 New building work, including extensions and substantial adaptations to existing accommodation, will normally be designed, procured and supervised by professional building consultants. Depending on the nature of the work, this service will usually cost between 10% and 15% of the value of the building contract. The fee will cover the cost of employing, where appropriate, architects, engineers and surveyors. There will be an additional cost if full planning approval is required. The respective professional institutions will supply details of the services that can be provided as well as information on fees.

6.2 The value of the building contract on which a fee is assessed will usually include fixed furniture and fittings, eg. shelving, benching and cupboards. Care should be taken to ensure that fees are not paid on the value of items which, whilst forming part of the main building contract, have been independently designed, procured and fixed by a specialist contractor. This is because the cost of providing these services will have been included within the price for the work.

Value Added Tax

6.3 Under current regulations most school building work will attract VAT at the standard rate, although for LEA school building projects any VAT payable is recoverable by the local authority.

6.4 In the case of free-standing buildings and some types of extension projects at schools which have charitable status, the work is zero rated.[2] Adaptations to existing buildings, furniture and equipment and professional fees are standard rated whatever the type of project. DfEE grant aid will cover the additional burden of VAT (for the grant aided portion of the work) where payable.

6.5 As VAT can have a considerable impact on the cost of a project, advice on its application should be sought from the local HM Customs and Excise Office at an early stage in the planning and design process.

Project Phasing

6.6 When it is necessary to consider phasing building work over a period of time, the additional costs associated with carrying out a number of small building projects instead of a single large one will need to be allowed for when the initial budget is set. Funding for phased educational projects is usually contingent upon each phase providing accommodation that will be fully operational in the event of further funds not becoming available.

New Building versus Adaptation/Refurbishment

6.7 Constructing and fitting out a completely new music suite building can cost between £800 and £1100[1] per m^2 of gross floor area provided. These costs include building work, furniture, equipment, site works and professional fees, but exclude abnormals, land purchase costs and VAT. Factors influencing the cost include briefing requirements, standard of specification, site condition and ease of access, the size of the project, and whether the building is single or multi-storey.

6.8 The costs of adapting and refurbishing existing buildings tend to be more variable. They depend on the degree to which the existing structure and services need to be altered and on the

Notes

[1] All costs given in this Section are at third quarter 1996 national average prices.

[2] Zero rating also applies to the services of constructing ramps and widening doorways or passageways to improve access for people with disabilities, and to certain items of equipment, such as hearing loops, designed solely for use by people with disabilities.

amount of existing furniture and equipment that is re-used. In the case of refurbishment requiring, for instance, only redecoration and a few extra service outlets and where there is substantial re-use of existing furniture and equipment, the costs may be less than 10% of the cost of new.

6.9 In larger projects involving extensive structural remodelling and renewal of services and where new furniture and equipment is provided, the costs can approach those of a new building.

6.10 Where there is a choice between building new and adapting or refurbishing existing accommodation, the latter will usually provide a more economic solution as not only are the capital costs likely to be lower, the overall floor area does not increase, hence additional, recurrent costs will be avoided. These can cost approximately £40 per m² of gross floor area annually. In addition, the adaptation or refurbishment of an existing building may make it easier to create or maintain appropriate links between existing curriculum areas.

6.11 All projects, whether for new building, adaptation or refurbishment, should be considered in the context of a school's overall long term building development plan.

Temporary Accommodation Costs

6.12 Outright purchase and installation of temporary buildings fully fitted with furniture and equipment can cost between £360 and £500 per m² (excluding VAT). Temporary buildings can provide a cost effective solution to a short term accommodation need, eg. during building work, or to accommodate a short term peak in a school's roll. However, the possible disadvantages of using a temporary building for music teaching in particular include:

- **Location:** supplementary spaces such as group rooms may not be close by;
- **Reduced security:** construction is generally lightweight and access may be possible from all sides;
- **Variable and possible extremes of temperature:** heating is likely to be from local emitters and only used when the space is occupied;
- **Acoustics:** it may not be cost effective to provide the same level of acoustic performance as for a permanent building; the walls which are generally of lightweight construction provide little sound insulation from outside and between rooms.

Furniture and Equipment (F&E)

6.13 In some Local Education Authorities the procurement of furniture and equipment, sometimes both fixed and loose, is managed by the authority's supplies organisation. As an authority-wide service its cost may not always be attributed directly to individual projects.

6.14 Procurement costs will, however, need to be taken into account in projects at Grant Maintained and other schools which do not automatically receive support from an LEA supplies organisation. In these cases it may be necessary to employ the project architect or another agency to provide the procurement service. This can cost up to 6% of the value of the furniture and equipment supplied. In smaller projects this work is sometimes undertaken by the school itself.

Case Study Cost Analysis

6.15 Figure 6/1 provides a model cost analysis (based on budget prices) of the building work and furniture and equipment for Case Study 1, described in Section 5. The costs are subdivided into the main elements together with building costs per m².

Building Costs

6.16 The building costs relate to the alterations necessary to refurbish the existing workshop and include for:

- minor internal demolition;
- closing and forming openings, replacement of external and internal doors;
- replacement of windows to NW elevation with rendered blockwork and new windows at high level;
- secondary double glazing to SE elevation;
- new internal partitions and doors;
- new floor finishes;
- full redecoration throughout;
- upgraded electrical installation;
- independent heating system to ensemble and group rooms;
- acoustic treatment to internal walls;
- preliminaries and contingencies.

6.17 No allowance has been made for making good any defects to the building envelope, although there is a contingency sum within the costings to deal with any minor problems should they arise.

Fixtures and Fittings Costs

6.18 These include:

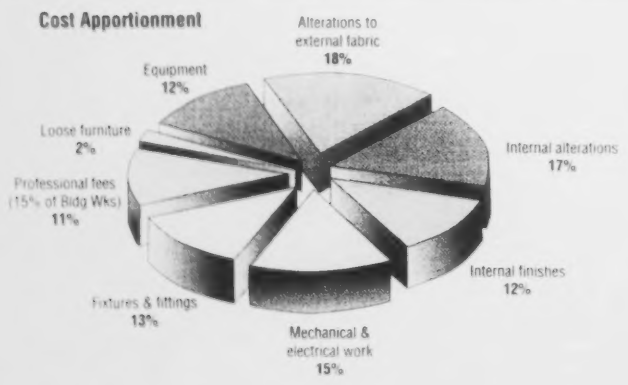
- heavy drapes;
- worktops, cupboards and shelves;
- whiteboards;
- all associated builders work.

Furniture and Equipment

6.19 The costs in Figure 6/1 allow for new furniture and equipment including a basic complement of tables, chairs, equipment trolleys, keyboards and music stands.

Figure 6/1
Case study cost analysis

	Cost	Cost
Budget Cost Elements:	£	£/m²
Alterations to external fabric	6,344	66
Internal alterations	6,012	63
Internal finishes	4,380	46
Mechanical & electrical work	5,200	54
Fixtures & fittings	4,420	46
Building Works Total	**26,356**	**275**
Professional fees (15% of Bldg Wks)	3,953	
Loose furniture	800	
Equipment	4,100	
Estimated Total Project Cost	**35,209**	



Cost Comment

6.20 The cost analysis highlights the significance of the cost of fixtures and fittings and furniture and equipment as a proportion of the overall budget. In a music suite, acoustic treatment is necessary but savings can be made by re-using existing furniture.

6.21 The cost of contract grade carpet is included as an economic and practical choice. Carpet tiles were not considered sufficiently resilient in an environment where frequent rearrangement of furniture and heavy equipment occurs.

6.22 Another consideration will be the treatment of the external fabric; in this example, the existing external wall area is 36% glazed, presenting problems for acoustics, security, solar gain and thermal insulation. Secondary glazing is beneficial but consideration should be given to reducing the overall level of glazing as in this project.

6.23 The refurbishment of existing accommodation normally leads to lower recurrent costs.

Appendix 1: Check List of Design Considerations

The Music Suite

Range of Spaces

The following range of spaces will support both timetabled music lessons and extended curricular activities.

- One or more whole class teaching spaces, to suit the number of music teaching periods.
- A series of small spaces for composition exercises as part of class work, practice and instrumental lessons.
- A recording/control room for recording pupils' performances in adjacent spaces and teaching principles of music technology.
- Storage areas for instruments, books, music scores etc.
- A staff base for mainstream and peripatetic teachers.

Rehearsals and performances to an audience may take place in an ensemble room, music classroom, the school hall or drama studio, depending on the scale of the event.

The Location on the School Site

When looking at the location of the music department, consider the following points.

- If integral with the school, it may be difficult to provide the necessary sound insulation (eg. from other teaching activities). If detached, the department may feel more remote.
- The need for sound insulation from outside disturbance such as playground noise or traffic must be borne in mind.
- If the music department is adjacent to a related space such as the drama studio, there can be opportunities for shared use.

The Plan

When planning the department consider the following.

- Locating all music spaces together can facilitate interaction between teachers and more shared use of ancillary space.
- Non-teaching areas such as store rooms or circulation space can be used to provide acoustic separation between teaching spaces.
- The recording/control room should be located to allow visual as well as audio contact during recordings.
- Pupils and staff should be able to access instruments and use a room for instrumental lessons without disturbing other activities.
- Accessibility and security are particularly important if the suite is to be used after school hours.

Individual Spaces

Size of a Music Classroom

An area of **60-70m²** can accommodate up to 30 pupils engaged in a wide range of musical activities. A space of **79-91m²** can provide additional scope for rehearsals/performance.

Planning a Music Room

The furniture layout of the music room should be flexible and able to accommodate:

- whole class composing and performing;
- small group composing and performing;
- keyboard work by individuals, small groups and a whole class;
- whole class discussion/evaluation;
- a teaching focus to include the teacher's piano/keyboard, audio system, whiteboard and control switches;
- storage and display space for instruments.

Support Spaces

- A room of **6-8m²** will accommodate small composition groups and instrumental lessons.
- A room of **20-25m²** allows for larger groups or particular instruments.
- A recording/control room of **10-15m²** will contain recording equipment for the suite and should have a high level of sound insulation.

Storage

The storage of reference material and instruments will be divided between classroom, class store and instrument store. The last should be secure but accessible.

Furniture and Equipment

Furniture should allow the music room to accommodate a variety of activities easily. The following points are useful to note.

- Tables should be easy to move but sufficiently robust to withstand frequent re-arrangement.
- Tables are available in a variety of shapes and frame types. Trapezoidal tables offer advantages of basic wire management and the ability to create a variety of group formations.
- Stackable moulded plastic chairs are inexpensive, easy to clean and lightweight. Adjustable chairs may be desirable for use with computers.
- If storage units are mobile, they can be moved to provide additional horizontal display and work surface in the music classroom.
- A shelving system for instruments should have strength and flexibility.
- Demountable staging can be arranged in a number of ways to accommodate performances of varying size.
- Pinboard can be used for display and can, in varying ways, form part of the acoustic treatment to a music room.

Services and Environmental Design

Electricity

All installations must comply with the relevant regulations. Electronic keyboards need to be serviced safely and conveniently via a low voltage supply which may be supplied directly or via transformers. Floor mounted boxes may be considered.

Acoustics

There are two principle factors affecting a successful acoustic environment.

- **Sound insulation** from other sounds which could cause disturbance. This is achieved by planning and construction. Mass is generally the best insulant and any weak elements can reduce the effectiveness.
- **Sound quality** within the room itself. The two key parameters are room volume and surface finishes. It is necessary to have ample room volume to provide the required length of reverberation ie. reverberation time. This must be co-ordinated with appropriate surface finishes. Hard surfaces reflect sound and tend to prolong reverberation. Soft porous surfaces absorb sound and tend to shorten reverberation.

It is an advantage to provide audio links from the recording/control room to all spaces where musical performances take place.

Lighting

Daylight is the preferred light source in a teaching space but consider:

- windows reduce the acoustic insulation of a wall;
- rain on rooflights may cause disturbance.

Cost Guidance

Consideration should also be given to the following:

- professional fees can add a further 10-15% to the cost of new accommodation.
- The local customs and excise office should be consulted on the question of VAT.
- The cost of a new music block can vary from £800/m² to £1100/m². The cost of adapting existing spaces may be less than half of this.

Appendix 2: Glossary I: General terms

BUFFER ZONES: Neutral spaces such as corridors or storerooms used to protect areas requiring acoustic insulation.

CD ROM: Compact Disc Read Only Memory - computerised reference material.

ENSEMBLE ROOM: Group room used for small group performance and rehearsal particularly at GCSE level and by instrumentalists.

EVALUATION: Class or small group assessment/feedback occurring after or during an activity such as a performance.

EXTENDED CURRICULAR LESSONS: Lessons occurring outside normal timetabled curriculum time.

FREQUENCY OF USE (%): The average amount of time a space is used, expressed as a percentage of the total number of teaching periods available.

F&E: Furniture and Equipment.

FTE: Full Time Equivalent - the number of full time teachers that equates to a combination of full and part-time teachers.

GROUP ROOM: Small supplementary teaching space used in conjunction with music classroom for classwork composition - may be used for peripatetic lessons if available.

KEY STAGES (KS): Statutory years in secondary school are divided into two phases of development. These approximate to ages as follows:

KS3: ages 11-14.

KS4: ages 14-16.

LEA: Local Education Authority.

MUSIC CLASSROOM: Space to accommodate music lessons with whole class (seated) simultaneously.

OHP: Overhead Projector.

PERFORMANCE AREA: Space used for informal presentations often as part of classwork.

PERIPATETIC: In a musical context, teachers who visit the school to give vocal or instrumental lessons.

RECITAL SPACE: Space used for more formal performances to an audience.

RECORDING/CONTROL ROOM: Space accommodating equipment used to make sound recordings.

RECORDING STUDIO: Space which accommodates the musicians during a recording session.

SUITE: In this publication a suite refers to a group of same-subject rooms.

TEACHING PERIOD: Schools divide up the week into a number of periods. For example 40 periods of 35 minutes.

TEACHING WALL: Wall facing the class, main teaching focus (whiteboard etc.).

VDU: Visual display unit (computer screen).

WORK PLACE: A place to work (usually table surface and seat) for one pupil.

YEARS 7 TO 11: Secondary school years are numbered from 7 (first year) to 11 (end of statutory schooling). Years 12 and 13 are sometimes referred to as the sixth form.

Appendix 3: Glossary II: Acoustical terms

BACKGROUND NOISE: Noise from all sources other than a particular sound that is of interest.

COLOURATION: Distortion of sound from an instrument or loudspeaker by strong short delay reflections or standing waves in a room.

ECHO: Sound that has been reflected and arrives with such a magnitude and time interval after the direct sound as to be distinguishable as a repetition of it. Note: the term 'echo' is limited in common usage to reflection distinguishable by the ear.

FLUTTER ECHO: A rapid succession of echoes originating from the same sound source.

SOUND DIFFUSION: Dispersion of sound within a space so that there is uniform energy density throughout the space (good sound diffusion also implies the lack of strong standing waves which can cause undesirable enhancement of sound at certain frequencies).

SOUND INSULATION: The use of structures and materials designed to reduce the transmission of sound from one room or area of a building to another, from the exterior to the interior of a building or between the interior and exterior of a building.

STANDING WAVES: Caused by interference between two waves travelling in opposite directions, often between parallel walls. Sound pressure maxima and minima are formed which can colour the original sound.

Definition of acoustic terms and units taken from DN 17.

$L_{Aeq,T}$. The equivalent continuous A-weight sound pressure level. This is a notional steady sound which, over a defined period of time T, would have the same A-weighted acoustic energy as a fluctuating noise, eg., for a 1 hour school lesson this would be denoted $L_{Aeq,1hr}$.

A-weighted sound pressure level, dB(A). The unit in decibels, generally used for measuring environmental and traffic noise. An A-weighted network can be built into a sound level meter so that dB(A) values can be read directly from the meter. The weighting is based on the frequency response of the human ear and has been found to correlate well with human subjective responses to various sounds. It is worth noting that an increase or decrease of approximately 10dB(A) corresponds to a subjective doubling or halving of the loudness of a noise, while a change of 2 to 3dB(A) is subjectively just perceptible.

Decibel(dB). The decibel is a unit of sound level using a logarithmic scale.

Reverberation. The persistence of sound within a space after the source has ceased.

Reverberation time (RT). The time in seconds required for a sound to decay to inaudibility after the source ceases; strictly, the time in seconds for the sound level to decay 60dB (mid-frequency value of RT is the mean of the values in the octaves centred on 500Hz and 1000 Hz).

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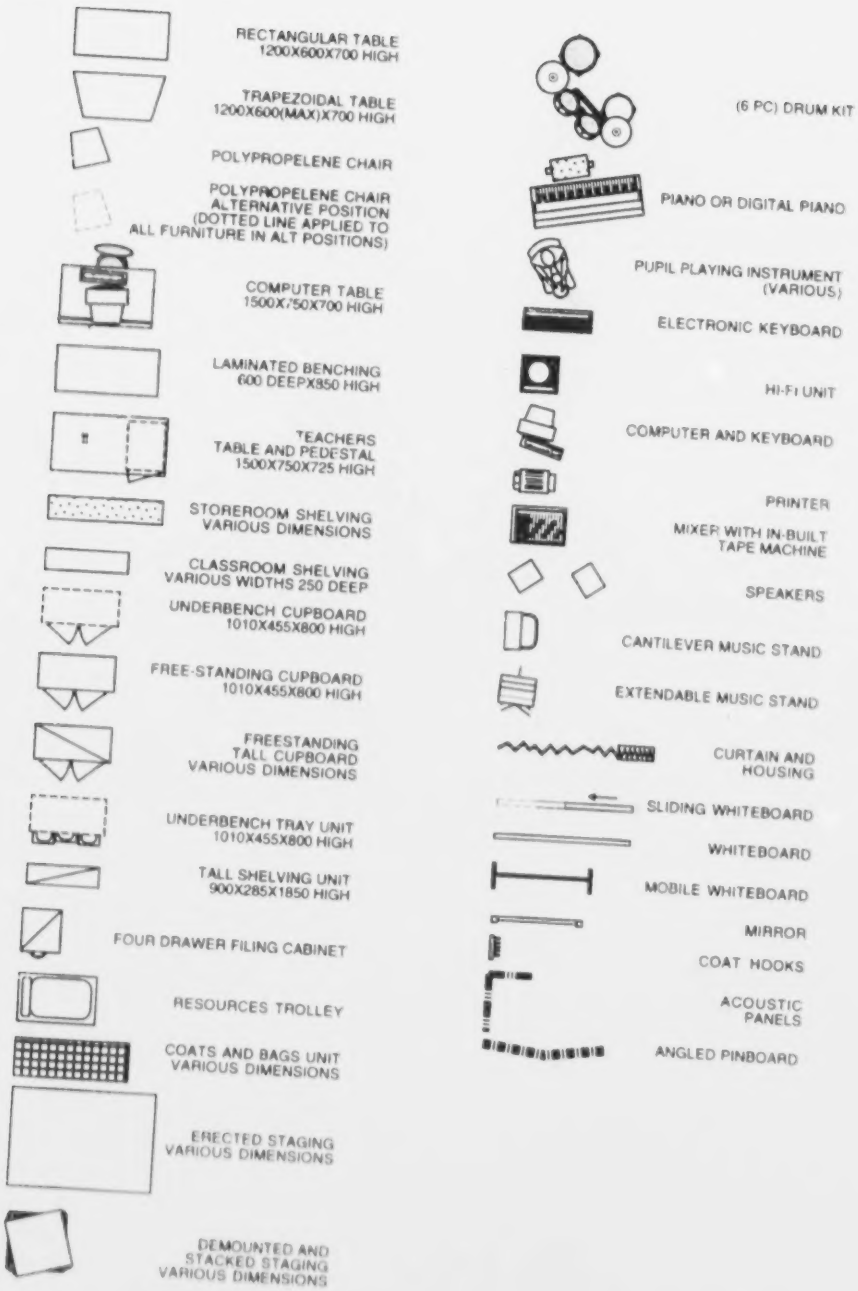

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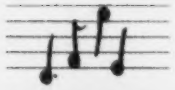

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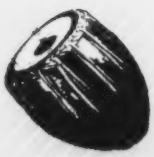

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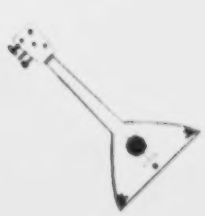

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